CHEMICAL
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ENGINEERING

Chem & Met

JANUARY, 1942

NOW TO BE BLACKED-OUT FOR THE DURATION

Putting out the lights on Eastern oil refineries won't curtail their vital contribution to America's Victory Program. Petroleum's place in our war economy is dramatically reviewed on pp. 84-5. See also Chem & Met. report on War-Time Protection of Industrial Plants, pp. 101-8.

NOT YET JAPANESE BOMBS BUT ON THEIR WAY

These old fashioned earthenware carboys for sulphuric acid are not so typical of the more modern chemical industries that are now serving the war lords of the Little Germany of the East. Read on pp. 80-3 "Our Enemies, Chemically Speaking."

SMOOTHING THE WRINKLES FROM MASS PRODUCTION

Continuous production of plate glass, first practiced in Creighton works of Pittsburgh Plate Glass Co., added another distinction to this plant that was the company's first to produce laminated safety glass. Chemical engineering operations described and pictured in flowsheet on pp. 114-7.

WASHINGTON NEWS pp. 122-123

Chem & Met

NEXT MONTH

With our country now at war, there are many understandable restrictions on material which may be published. But certain basic statistical guide-posts are just as vital to all-out production for war as for peace. With these limitations as well as needs carefully in mind, the editors bring you in February, *Chem. & Met.'s* Nineteenth Annual Review and Statistical Number. "Facts and Figures of American Chemical Industry, IV" is going to show our progress in converting chemical production into an efficient machine for serving wartime demands as well as essential civilian needs.

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CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

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CHEMICAL
& METALLURGICAL
# ENGINEERING

ESTABLISHED 1902 S. D. KIRKPATRICK, *Editor*

JANUARY, 1942

Chemical Industry in the War

CAREFUL reading of Bernard M. Baruch's recent book on industrial mobilization ("American Industry in the War," Prentice-Hall, 1941), serves as a timely reminder of the vital part played by chemicals in our first World War effort. As early as April 1917 a chemicals committee had been formed under the raw materials division of the old Council of National Defense. When, later, the War Industries Board was organized, Mr. Baruch insisted that the chairman of this chemicals committee should serve as his technical advisor and become an official member of the Board. That man was Leland L. Summers, a consulting engineer, who, since 1915, had been prominently identified with the purchase of chemical munitions for the Allied governments. During all of the Board's activities, Mr. Summers sat as one of its eight members, sharing industrial representation with only Mr. Replogle, the steel administrator, and Mr. Peek, commissioner of finished products. Mr. Summers also insisted on remaining the administrative head of both the explosives and chemical divisions—the former directed by March F. Chase and the latter by Charles H. MacDowell, ably assisted by approximately twenty sectional chiefs drafted from the executive ranks of the various chemical industries.

This much of history is reviewed here to point a contrast and perhaps as the basis for some questions about our representation in the current war effort. Obviously chemicals are no less important now than they were twenty-five years ago, although it is true that today we are much better prepared because of our highly developed chemical industry. But does that mean there is no longer the need for adequate and aggressive representation of our industry by some of its top executives serving on the various planning boards that are now directing the war program? Must chemicals continue to be subordinated to other industries, shrouded with mystery and misunderstanding? Perhaps such questions may seem ungenerous or unfair to the many patriotic, competent and hard-working technologists who have ably represented chemical industry in OPM and OPA. Certainly that is not intended. Rather, these questions reflect an impression that is rather widely prevalent in chemical industries. Many people are beginning to ask, perhaps inadvisedly, why the names of the members of the various chemical advisory committees have not been made public, why the organization and procedures of the chemical units are not better understood, why everything "chemical" is a military secret which can be shared only with those in the inner circles?

Tanks, planes and battleships are units that can be readily understood and visualized by anyone. They are made largely of metals and there seem to be no

secrets about war requirements for steel and copper, aluminum and magnesium. Our needs for uniforms, shoes, and similar supplies are a simple matter of arithmetic. But when it comes to smokeless powder and TNT, or even their basic chemical ingredients, there is little or nothing known except to those within the charmed circles. Yet if the United States is soon to put the victory program into full operation, there may well be some advantage in carrying information of this sort to engineers and managers of chemical enterprises all over the country. Certainly the expanding needs for additional personnel, as well as production facilities, would seem to argue in favor of more general release of such information as would not be of help to our enemies.

Our big job in 1942 is to achieve a full mobilization of American chemical industry. In the words Donald Nelson addressed to a group of business-paper editors on December 19, this "means drastic changes in our existing industrial economy. We must now think only in terms of out-producing a powerful enemy; and anyone who under-estimates the ability of the enemy to produce is only kidding himself." This job of converting chemical industry into a great, efficient war machine is one that calls for the united effort and support of all of us, whether in small companies or large corporations, whether now producing war materials or essential civilian goods.

American chemical industry served with great distinction in the last war, despite the fact that it was young and inexperienced. So far in the present effort it has done its share and has set fine records for efficient production as well as whole-hearted cooperation with the government. But we can and must go a lot farther and faster. We need to mobilize every chemical resource in manpower, materials and plant facilities. We need strong and vigorous leadership.

BILLIONS FOR DEFENSE

As of January 1, 1942, according to the OPM Bureau of Research and Statistics, there have been approximately 71 billion dollars of appropriations, contracts and authorizations in the defense program. The largest single item in the tabulation is for ordnance, including naval ordnance, which accounts for 16.5 billions or 23 percent of the total program. Other munitions add 3.5 billions, stockpiles, equipment and supplies, 6.6 billions; so that at least 37 percent of our money has been earmarked for materiel of direct concern to chemical engineers. Just what proportion of this staggering total is represented by chemicals and explosives, as such, has not been shown, but we would estimate it as at least a fifth of the total for these three items.

The same Bureau reveals that from the beginning of the defense program through September 30, 1941, industrial facilities for defense financed by the government and privately, totaled $5,260,463,000. Here chemicals, including explosives, accounted for 13.8 percent, petroleum, coal and gas, 0.7 percent, and ammunition, shells and bombs an additional 16.2 percent. Again it seems safe to estimate that chemical engineering construction has accounted for at least a fifth of the industrial facilities for defense. This figure of approximately a billion dollars is about ten times the normal building program in our field. And it must be greatly increased as the victory program swings into full operation.

So, with $15,000,000,000 already appropriated for chemical munitions, with at least another billion in new defense plants, and more in the offing, "billions for defense" is not just an idle boast. It's chemical industry's biggest order for 1942 delivery.

ADJOURN REFORM

Reform has not been adjourned for the war. One would think that official Washington would lay aside its hobbies and get down exclusively to war business. Unfortunately this is not the case. Complete licensing of explosives producers, distributors and users has begun. The government is taking over more power properties nominally for defense, actually to get operating control. The President has named a new patent board to figure out how the patent system can be revised. An obvious objective is to get more control of patents, not to make patents more the servant of industry and the public. And Secretary Ickes outdoes himself in reform

Volume 49—Chemical & Metallurgical Engineering—Number 1

Chemical & Metallurgical Engineering is the successor to *Metallurgical & Chemical Engineering*, which in turn was a consolidation of *Electrochemical & Metallurgical Industry* and *Iron & Steel Magazine*, effected in July, 1906.

The magazine was originally founded as *Electrochemical Industry*, in September, 1902, and was published monthly under the editorial direction of Dr. E. F. Roeber. It continued under that title until January, 1905, when it was changed to *Electrochemical & Metallurgical Industry*. In July, 1906, the consolidation was made with *Iron & Steel Magazine*, which had been founded eight years previously by Dr. Albert Sauveur. In January, 1910, the title was changed to *Metallurgical & Chemical Engineering*, and semi-monthly publication was begun Sept. 1, 1915. On July 1, 1918, the present title was assumed and weekly publication was begun Oct. 1, 1919. Monthly publication was resumed in March, 1925.

Dr. E. F. Roeber was editor of the paper from the time it was founded until his death on Oct. 17, 1917. After a brief interim he was succeeded by H. C. Parmelee. Ten years later, Nov. 1, 1928, Mr. Parmelee assumed other responsibilities in the McGraw-Hill Publishing Company and Sidney D. Kirkpatrick was appointed editor.

The present editorial staff of the magazine comprises, in addition to Mr. Kirkpatrick: James A. Lee, managing editor; H. M. Batters, market editor; T. R. Olive, associate editor, J. R. Callaham and L. B. Pope, assistant editors. R. S. McBride, William E. Becker, E. S. Stateler and Earle Mauldin are editorial representatives in Washington, D. C., on the Pacific Coast, in Chicago, and in Atlanta, respectively.

effort as he takes over his duties as solid fuels czar and greatly extends his disciplinary rules over the petroleum industry. Using wartime authority for reform seems to be a hobby of the Interior Department.

SYSTEMATIC VS. SPORADIC SAVINGS

Most people, especially since December 7, don't need to be told why they should buy more defense bonds. We know it is a patriotic duty as well as a personal privilege to invest our savings in the future of America. But some of us put it off, or contribute sporadically, for the simple reason we have no definite plan of procedure. If that is the case in your organization, you will do well to investigate the voluntary pay-roll allotment plan that is now being widely adopted by small as well as large companies in our industries. Remember that France left it to hit-or-miss—and missed. Let's hit and hit hard, week by week, month by month, until our combined efforts result in American victory.

WASHINGTON HIGHLIGHTS

ALLOCATIONS proceed apace. Already there are 15 or 20 commodities you can't own or process without Uncle Sam's OK. Most of them are imported strategics like rubber, tin, and chromium. But the equivalent procedure will apply to more and more chemicals as mandatory allocations replace priorities. What has already happened to chlorine, methanol and ferro-alloys shows what to expect for other chemicals.

SABOTAGE, incendiarism and enemy air raids, but the greatest hazard of them all in chemical industry, is sabotage. Read in this month's *Chem. & Met.* report (pp. 101-8) the best advice the editors have been able to glean from the Office of Civilian Defense, the Chemical Warfare Service, the Federal Bureau of Investigation and numerous other sources.

SUBCONTRACTING in most chemical manufacturing is not so easy. But Washington expects more process industries to share in the defense load. This means that small plants, even those not commonly doing process work of the needed sort, can make their contribution to defense production. Such operators will not be a permanent part of our industries. But they can help now when even a small step in advancing goods toward completion for military use is desirable, in fact, necessary.

CHEMICAL PROMOTERS are not wanted in Washington. Direct action by executives of process industries in dealing with government officials is preferred. There is a place for the Washington representative in legal, tax, and technical matters. But he cannot safely, particularly at this time, be substituted for executive action by those who can speak directly on company policy. Government officials prefer to deal with career members of a staff, not temporary exponents of some "cause."

WASTE ELIMINATION, especially in use of metals and certain chemicals, is most vital. Even where it takes more labor, or causes increased cost, economy in consumption is sought. The United States had suddenly achieved an economic relationship like that which has long prevailed in Europe. This temporary situation means that we can waste labor to save material. We must pursue a policy of ruthless economy on materials. Nor must we lose sight of the fact that there are opportunities for simplification of specifications and the elimination of costly frills and excessive refinements.

PRICE REGULATION will come. In general, it will apply principally to consumers' prices. Thus, those industries like the fertlizer manufacturers, who sell to ultimate users, may be the first to be pinched. But also there will be many more specific industrial-commodity price-control orders such as those recently issued for alcohol, butanol, acetone, and glycerine. As these price controls develop it will be particularly important for engineers and executives of the chemical industries to know and identify clearly all new elements of cost. Generally speaking, only such *new* costs, especially those imposed by war conditions, will be assumed to justify price advances.

TAXES to supply one-third, perhaps more, of needed war money will be the ambition of Congress. This means that some of the extreme ideas previously reported as mere proposals of Washington come closer to reality week by week. The first tax law of 1943 may actually double the tax collector's "take" in many industries.

WAR CONTROLS must be recognized. Speed-up is expected. Demand for more continuous plant operations is certain. Better scheduling of hours of work, as in the Gray plan described on page 86, is worthy of immediate study. But with all the pressure of speed up, we must still watch out for the vital element of safety of plant and personnel. That alone can take precedence over increased output in these times.

U. S. MINISTRY OF SUPPLY, long delayed, is now in the making. Evidence that the government is becoming increasingly impatient with present procurement policies is accumulating. The President's demand for a \$50 billion per year spending program may sway the decision toward civilian control of purchasing. With needs mounting on such a grand scale, it's almost safe to say that chemical industry can't possibly plan for too much production of military necessities. Not so, of course, for civilian goods.

TANK CAR shortages are expected. Obviously there will not be as many tankers as needed for petroleum or molasses carriage. Even more obviously, the burden on rail transportation by increased business is already overloading our liquid-carrying facilities. This means that economy in tank car usage, prompt unloading, quick return, and simply doing without, will all be necessary. As statistics are issued regarding tank car supply, it will be important to note that the Association of American Railroads claims that a car is idle when it is not actually on their rails and moving. Hence, a tank car that is rendering full service, is classified as idle for a substantial percentage of its time, with weird statistical results on occasion.

Our Enemies, Chemically Speaking

KARL FALK, *Fresno State College, Fresno, Calif.*

Chem. & Met. INTERPRETATION

Because the present World War is being fought in the industrial as well as the military sphere, this timely review of the economic and technical positions of the Axis chemical industries is distinctly in order. It has been prepared for *Chem. & Met.* largely by Dr. Falk, who formerly represented this magazine in Europe. While it clearly shows that we have formidable opposition in prosecuting both the war and the subsequent peace, nevertheless, the tremendous preponderance of basic raw materials, plants and personnel available to the non-Axis powers should more than counter-balance the initial advantages of close collaboration during almost a decade of chemical preparedness by our enemies.—*Editors.*

GERMANY, ITALY AND JAPAN, poor in resources but rich in ambition, have organized their industries under government direction to make the greatest possible use of available raw materials while trying to develop militarily independent and blockade-proof economies. In the Reich, lessons from the first World War were carefully studied and this accounts for the emphasis placed on synthetics even before the outbreak of this war. German chemicals were also used as an important medium of exchange to obtain on world markets reserve supplies of vital materials in which the Reich was deficient. This was possible since Germany's normal chemical exports are two to three times chemical imports. The Axis partners, Italy and Japan, normally import more chemicals—at least raw materials—than they export.

Before the outbreak of World War II, in *total chemical production* the Great Powers ranked as follows: United States, Germany, United Kingdom, France, Japan, Italy, and the U.S.S.R. United States accounted for two-fifths of world chemical production, while Germany supplied less than one-fifth. In *world trade* in chemicals, however, the order in 1938 was: Germany, United States, United Kingdom, France, Japan, Italy, U.S.S.R., with the Reich supplying between one-fourth and one-third the total and the U.S. one-sixth. The United States has been the world's largest chemical importer, and Germany the world's largest exporter.

Assuming that exports represented roughly a surplus over domestic needs and that raw materials were available—which is not always the case—and that war damage no more than cancelled out new plant construction since 1938, a breakdown of leading chemical traders into Anti-Axis, Axis, and countries accessible to the Axis (with important reservations for Switzerland's unique position, and for occupied parts of the U.S.S.R.) would be roughly as shown in Table I.

This breakdown, of course, fails to show the importance of British Empire and Latin American chemical raw material sources, but it also does not include the growing production of Scandinavian and Balkan countries which are accessible to the Axis.

GERMANY'S STRONG POSITION

Germany, as the largest Axis chemical manufacturer, bases its production chiefly on available raw materials, coal, lignite, potash, limestone, salt, wood, magnesite, and other raw materials. The Reich normally depends on foreign sources for vegetable oils, naval stores, crude drugs, phosphates, natural rubber, borax, sulphur, pyrites, carbon black, natural oil and petroleum, and other less important items. Some of these have now been successfully replaced by substitute or alternate materials. Germany's leading chemical exports normally are coal-tar dyes, potash, medicinals, ammonium sulphate, nitrogenous fertilizers, pigments, paints and varnishes, synthetic resins, insecticides, and other agricultural and industrial chemicals.

In certain chemicals the Reich is the world's chief producer. Of the 1939 world output of approximately 200,000 metric tons of dyestuffs, Germany accounted for the largest share, exporting about one-third of its production and supplying 56 percent of the total international trade in these products. In normal years the Reich exports 50 percent and more of its dye output.

Of the world's 3 million metric ton output of nitrogen in 1938-9, German synthetic ammonia plants with a capacity of 1.4 to 1.5 million tons supplied the largest share. Most of the Reich's production of synthetic ammonia is from brown coal water-gas and is manufactured in I.G. plants at Leuna and Oppau near Ludwigshafen.

Germany is also the world's largest producer and exporter of potash, having strengthened its monopoly still further through recent incorporation of 11 Alsatian potash mines. In 1937 Germany produced 62 percent and France 15 percent of the world's potash.

Although figures are no longer accurate, Germany claims to have been the world's largest producer of aluminum in 1938, with 165,000 tons. In 1939 it produced 210,000 tons or 32 percent of the world output, which has increased considerably since then. Raw materials for this militarily important metal are not found in the

Table I—Foreign trade of principal countries in chemicals and allied products*

	Imports (millions)	Exports (millions)
ANTI-AXIS		
United States	$146.0	$158.5
United Kingdom	117.3	131.7
Canada	38.4	20.5
U.S.S.R. (1937 estimate)	6.7	13.4
Total	$308.4	$324.1
AXIS		
Germany	$84.2	$263.3
Japan	46.1	34.8
Italy	29.5	29.7
Total	$159.8	$327.8
ACCESSIBLE TO AXIS		
France	$64.5	$90.6
Netherlands	55.0	48.6
Belgium	48.4	62.2
Switzerland	24.5	40.7
Denmark	26.6	3.9
Poland and Danzig	14.2	6.1
Total	$233.2	$252.1

*From "World Chemical Developments in 1938," U. S. Department of Commerce.

Reich, but bauxite is available from Hungary and Yugoslavia, France and Italy. Germany is also an important magnesium producer, especially with control of magnesite supplies of Austria the world's second largest producer.

In 1939 the Reich produced 2.8 million metric tons of sulphuric acid, a new peak for Germany caused by increased demands for manufacturing artificial fibers, mineral oils, nitration products, fertilizers and munitions. It also imports considerable sulphuric acid and the raw materials, sulphur and pyrites, from Italy, Spain, Norway, Sweden, and Yugoslavia. Pyrite and iron ore from Sweden, northern France and elsewhere will probably enable Germany to keep up steel production, which was 23 million tons in 1938.

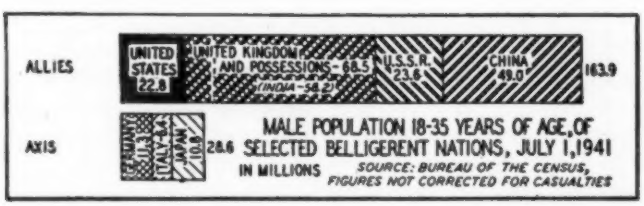
Germany is behind the United States, however, in the output of plastics and rayon, but leads in synthetic rubber, synthetic motor fuels, and staple fiber. Although production of these items has expanded tremendously in the last five years the Reich is still unable to fulfill domestic requirements with synthetic products. Synthetic rubber, chiefly Buna types, accounted for only 40 percent of the rubber consumed in the Reich in 1939. Of necessity, the percentage is probably higher now, and the same ratio would probably hold for synthetic textiles. In 1941, 30 plants in the Reich produced around 30 million barrels of synthetic motor fuels, thereby trebling the 1938 output. In that year, however, Europe consumed 200 million barrels of oil and produced only 75 million itself, not counting Soviet production, little of which was available for export. The rest had to be imported from overseas.

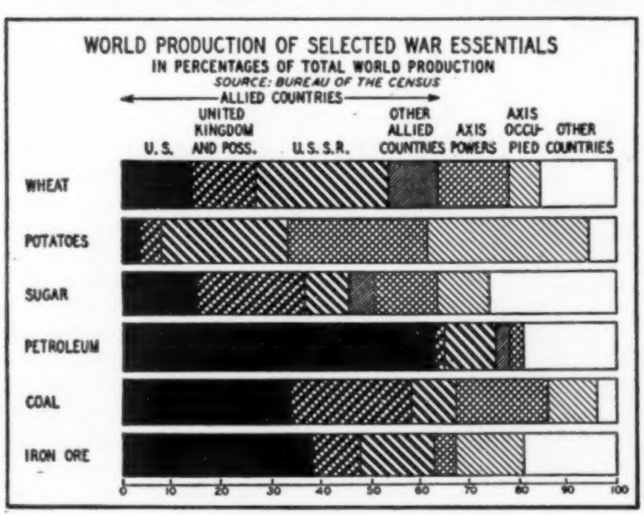
Although the Reich exports superphosphates, it must import phosphate rock. Normally this has come from the United States, but in war time is available from France and Italy. The Reich is far behind the United States in this fertilizer item as well as in output of chlorine and alkalies such as soda ash and caustic soda, needed for manufacture of artificial fibers and other synthetics.

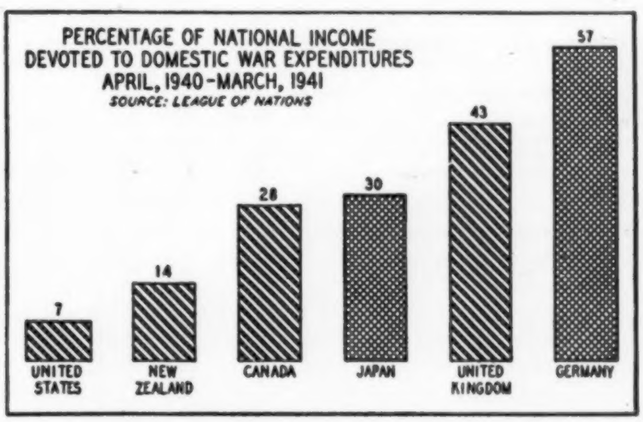
The Reich chemical industry, with a production valued at well over 6,000 million RM per year, ranks among the first five industries in Germany, and accounts for approximately one-fifth of that country's exports. Through the annexation of Austria and most of Czechoslovakia in 1938-9, before the outbreak of the war the chemical industry acquired an additional annual production of 400 million RM, and it is impossible to estimate what share other voluntary and involuntary Axis partners have contributed in the meantime in the chemical field. Poland has considerable capacity and raw materials, and France and Belgium are among the world's leading chemical producers. It must be remembered that conditions are in a constant state of flux, and it would be a mistake to assume these countries as operating at full capacity, while the changing theatres of war and adaptation of production to war time needs has changed the Reich's own production. As far as the other countries are concerned Germany supplies or withholds raw materials as its own needs dictate.

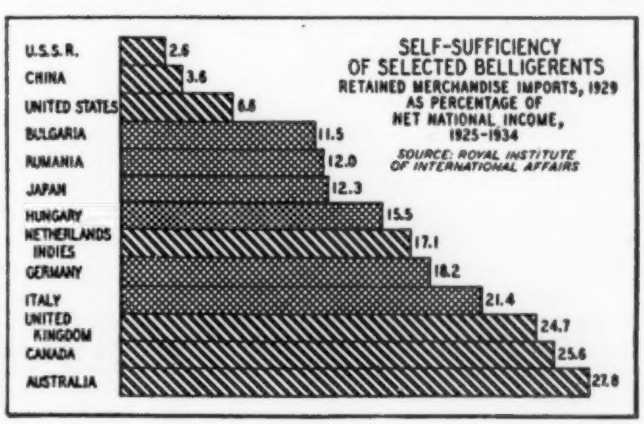
Reich chemical and allied industries, employing over 600,000 persons, have experienced a new boom since the outbreak of the war. Production had reached a new peak in 1939. At the outbreak of the war the publication of all statistical data was discontinued for military reasons. It is known, however, that the output receded in such lines as dyes, paints and pigments, soaps and other consumer goods, while it increased greatly in industrial chemicals required for producing domestic substitute or alternate materials or for the manufacture of munitions and other military needs. Marked gains are reported, for example, in the manufacture of sulphuric, nitric, acetic, and other industrial acids, alkalies, electrochemical products, carbon bisulphide, coal-tar derivatives, and related materials. An indication of the

Men and materials for war, as graphically presented by the National Industrial Conference Board in its *Economic Record* for December 24, 1941. See also Table I on page 82









extent of further production increases since the war started may be taken from the recently published report of the German A.G. Dynamit Nobel, manufacturer of explosives, celluloid, plastics, etc., which announced that in 1940 production had been 50 percent higher than in 1939.

Continental Plans—German plans to make Europe self-sufficient in the chemical field were revealed in the middle of 1941 by I.G. Farbenindustrie, which has just boosted its capitalization to 800 million RM in order to increase participation in foreign industries. Since France and England have been largely eliminated as competitors on the continent under wartime conditions, some of the "New Order" plans have already been put into effect. They call for complete continental reorganization of the chemical industry, with Reich interests taking over financial control in some instances, building new plants or expanding old ones in areas best suited by reason of location of raw materials or cheap power or labor. Plants requiring an abundance of electricity would be located in Scandinavian countries. For example, Norway could supply synthetic fertilizers and aluminum to France, Spain and the Balkans. In return, France could send bauxite needed for aluminum production to Norway. Yugoslavia, able to build an electrochemical industry on the basis of cheap power, labor, river transport, and possessing copper (German interests have recently acquired the formerly French-owned Bor mines), bauxite, chrome, antimony, lead, zinc, and timber as raw materials would become the center of the Balkan chemical industry, with Bulgaria and other southeastern European countries supplying additional raw materials.

In Rumania a specialized chemical branch would be built around the mineral oils (formerly Anglo-Dutch, American, and French-owned) and vegetable oils found there. After careful studies of the economic structure of southeastern Europe, I.G. Farben around 1935 started financing and supplying technical assistance to develop soya bean growing in Rumania. The proceeds from crops, purchased completely by Germany, were used for importing chemicals manufactured by I.G. In this way, while expanding the sale of chemicals, this firm also acquired foodstuffs and raw materials for the Reich, and I.G. economists have gone further and estimated that by raising per capita import purchasing power of the Balkans to one-half that of Germany, a billion mark gain of chemical exports to the Balkans would result, the bulk of which would presumably be supplied by the Reich.

In France, bauxite deposits would be developed further, and the existing well-rounded organic and inorganic industry would be expanded. France, it will be remembered, is the fourth largest chemical producer in the world. German financial penetration there was revealed with the announcement in December 1941 that I.G. Farben has obtained control of three leading French concerns, Kuhlmann, National Coloring Matters and Chemical Products Co., Ltd., of St. Denis, and French Chemical Products Co. of St. Clair du Rhone.

Lineup in Greatest War in the World's History

(Prepared by the U. S. Census Bureau from latest figures available)

Countries	Population (Millions)	Area, Thousands of Sq. Mi.	Density per Sq. Mi.	Wheat, Percent	Potatoes, Percent	Sugar, Percent	Petroleum, Percent	Coal, Percent	Iron Ore Products, Percent
THE WORLD	2,133	52,231	40.9	100	100	100	100	100	100
PRINCIPAL ANTI-AXIS BELLIGERENTS									
United States (Including Possessions)	151	3,734	40	14	4	15	63	34	38
United Kingdom (Including Possessions)	501	13,354	37	13	4	22	2	24	10
U.S.S. Russia	170	8,167	21	27	26	9	10	9	15
China	412	3,784	109	10	..	..	..	..	..
Netherlands Indies	69	735	94	..	..	5	3	..	..
Thailand	15	200	75	..	..	..	..	..	..
Total	1,318	29,983	44	64	34	51	78	67	63
PRINCIPAL AXIS BELLIGERENTS									
Germany (including Austria)	76	214	356	3	23	8	..	14	3
Finland	4	148	25	..	1	..	..	..	..
Hungary (Trianon Territory)	9	36	252	1	1	..	..	..	..
Italy	45	120	378	5	1	1	..	..	1
Roumania	19	111	175	2	1	..	3	..	..
Japan (including Korea and Formosa)	102	247	411	1	1	4	..	4	..
Manchukuo	43	503	86	1	..	..	..	1	..
Bulgaria (including So. Dobrudga)	7	43	156	1	..	..	..	..	..
Albania	1	11	97	..	..	..	..	..	..
Total	306	1,433	214	14	28	13	3	10	4
PRINCIPAL AXIS OCCUPIED AREAS									
Belgium	8	12	700	..	1	1	..	2	..
Czechoslovakia (before Sept., '38)	15	54	281	1	5	2	..	1	1
Denmark	4	17	225	..	1	1	..	..	..
Estonia	1	19	59	..	..	..	..	..	..
France	42	213	197	4	6	3	..	3	12
Greece	7	50	142	..	..	..	..	..	..
Latvia	2	25	78	..	1	..	..	..	..
Lithuania (including Memel)	3	22	118	..	1	..	..	..	..
Netherlands	9	13	679	..	1	1	..	1	..
Norway	3	125	23	..	..	..	..	..	1
Poland	35	150	232	1	16	2	..	3	..
Yugoslavia	16	96	164	1	1	..	..	..	..
French Indo-China	24	286	82	..	..	..	..	..	..
Total	168	1,082	155	7	33	10	..	10	14
RESOURCES MORE LIKELY AVAILABLE TO ANTI-AXIS GROUP									
Balance of North America (except U. S. and Canada)	37	1,780	67	..	..	13	2	..	..
South America (except foreign controlled)	94	6,921	14	3	..	5	9	..	1
Egypt	17	386	43	1	..	1	..	..	..
Iran	15	634	24	1	..	..	4	..	..
Iraq	4	117	32	..	..	..	2	..	..
Total	167	9,838	17	5	..	19	17	..	1
RESOURCES MORE LIKELY AVAILABLE TO AXIS GROUP									
Spain	26	194	134	..	..	1	..	..	..
Sweden	6	173	37	..	1	1	..	..	9
Total	32	367	88	..	1	2	..	..	9

European and Asiatic Turkey has a population of 17,870,000; occupies 297,000 square miles; has a density of 60; produces 2 percent of the world's wheat. This tabulation does not attempt to compute the proportion of normal Russian resources now controlled by German occupation nor the proportion of Chinese resources controlled by Japan as a result of occupation. Production figures shown will not always total 100 percent because productions of less than one percent are not included.

ITALIAN CHEMICAL PRODUCTION

Italy, although possessing a considerable electrochemical industry of her own which is rapidly being expanded, fits into the Axis picture as a supplier of certain manufactured chemicals to Danubian areas, but more as a source of raw materials, mercury, sulphur, pyrites, zinc, and bauxite. In the case of mercury Italy has become the world's largest producer (45 percent of the world total in 1937) when Spanish production was crippled during its year and a half of civil war. As the world's second largest producer of sulphur (10.7 percent of the world's total in 1937, 80 percent being U. S. produced), and fourth largest producer of pyrites (8.6 percent of world's total in 1937), Italy has a large surplus of raw materials for sulphuric acid.

Italy's chief sources of supply for

the chemical as well as other industries have become Germany and Yugoslavia, which has now been divided into the Kingdom of Croatia, ruled by the Italian Duke of Spoletto, Serbia, and in parts of Yugoslavia incorporated into the Reich by way of Austria, and those occupied by Bulgaria and Hungary. Former Yugoslavia had a surplus of cereals, meat, timber, copper, lead, chrome, and antimony, but the Reich is bidding against Italy for some of these items. In present wartime trade Germany is providing the southern axis partner with coal, steel, potash, and magnesite, and in return is receiving hemp and silk in addition to sulphur and mercury. Total trade between the two axis partners was reported in December 1941 to have tripled since 1939 and is supposed now to exceed 2,000 million RM.

The chemical industry has long been organized on a military basis by means of confederations and trade associations, with prices, exports, research, etc., all being government controlled. For both Italy and Germany the transition from a "Wehrwirtschaft" ("defense economy") to a "Kriegswirtschaft" ("war economy") was therefore easily accomplished. The same relative position occupied by I.G. Farben in Germany is held in Italy by Montecatini, Societa Generale per l'Industria Mineraria ed Agricola, Milan, largest chemical and mining concern of southern Europe, in which French, Swiss and German capital were still also represented as late as 1937. The present extent of foreign participation in this or any other chemical concern in Europe is not known, since such matters, along with production and operation figures that might be of military importance or of value to competitors, have always been carefully guarded secrets. Montecatini operates more than 200 plants either directly or as subsidiaries and affiliates, and accounts for the largest part of Italian chemical production. Its mining and metallurgical activities include numerous pyrite, sulphur, lead and zinc, lignite and bauxite mines.

Italy, with 9.6 percent of the world's total in 1937, follows France and Hungary as Europe's third largest bauxite producer. Montecatini produces roughly one-half of Italy's aluminum. Total Italian aluminum output was about 32,000 tons in 1939, 40,000 tons in 1940, and is predicted to reach 65,000 tons by 1942-3, with an eventual goal of 100,000 tons.

Magnesium production is comparatively recent, Italy's requirements having been imported until 1936. The Milan automotive and airplane Fraschini interests through the "SAMIS" organization started producing magnesium from dolomite in March 1940 and have two plants running and a third under construction in Bolzano, South Tyrol. Montecatini, which also erected a factory in Bolzano in 1938 is producing magnesium from the same raw material as well as by way of magnesium chloride from sea water. Total Italian magnesium production in 1942, however, will only be around 3,000 tons.

Thanks to synthetic production, the southern Axis partner is self-sufficient in nitrates, but deficient in potash and phosphates, phosphatic rock ordinarily being imported from the United States. Fertilizers are, of course, of great importance in Italy's drive to raise more farm products, especially wheat. Nitrogen fixation and synthetic nitric acid manufacture have expanded rapidly in recent years, although Italy is still behind Japan in total capacity. Domestic resources, such as coal, lignite, shale, and asphalt rock, have been utilized increasingly, chiefly by Montecatini, for making synthetic motor fuels. Production is still far behind the Reich. Rayon as well as staple fiber production, especially from casein, has also been expanded in the past few years. Production of essential oils, and organic and inorganic chemicals for export is well developed. Italy is the world's second largest producer of olive oil (24 percent of world's total in 1938-9), but is deficient in other vegetable oils.

JAPANESE CHEMICAL INDUSTRY

Japan's chemical development during the past ten years has been remarkable. Although still importing considerable chemicals, partly for military reasons, Japan in the past few years has also become an important exporter, especially in Eastern markets. The production value of Japanese chemicals and allied products was 851,000,000 yen ($238,800,000) in 1934. From 1935 to 1937 chemical output increased by more than 50 percent to a total of 1,424,594 yen ($400,000,000), of which industrial chemicals had a value of 506,950,000 yen; fertilizers 379,883,000; pharmaceuticals 123,574,000; soap, perfumery and toilet preparations, 109,631,000; and dyes and intermediates, 70,730,000 yen. Exports reached a peak of 188,300,000 yen ($48,000,000) in 1939, while imports dropped from a 1937 peak of 211,510,500 yen ($60,915,000) to 139,000,000 yen ($36,000,000) in 1939. The higher import figure was attributable partly to higher prices and partly to abnormal demands resulting from military activity. In 1938, 58 percent of Japan's chemical exports went to the yen-bloc Japanese-dominated areas of China, Kwantung Province, and Manchuria, while sharp declines were recorded to other countries such as the United States.

Japan's chemical industry, like that of the other Axis members is chiefly in the hands of a few large concerns as the Mitsui, Mitsubishi, Sumitomo, and electric enterprises. For price control and other official regulating functions the industry is divided into 22 major subdivisions, and in many cases is government subsidized, especially in undertakings outside of Japan proper or in unprofitable production.

Japan's chemical industry is based on its available raw materials, ordinary coal (not cokable), sulphur, pyrites, chrome, magnesite (in Manchukuo), and some copper and timber. In common with Axis partners it lacks cotton, wool, petroleum, and rubber. For fertilizers Japan has sufficient synthetic nitrate plants (over 8 percent of the world's installed capacity), but must import potash, phosphates, and soya bean cakes, partly from its mandated islands, and Korea and Manchukuo.

Japan is now self-sufficient in ammonium sulphate and some is even available for export in years when power shortages due to droughts do not occur as in 1934 and 1935 and 1939. Ammonium sulphate capacity in Japan proper, Chosen (Korea) and Manchukuo in 1935 was 1,625,800 tons, and has undoubtedly increased in the meantime. Superphosphate capacity is around 2 million tons, but raw materials have to be imported.

Since Japan has some copper it has not had the same incentive to developing aluminum as an alternate material as Germany and Italy. As a result of military needs, however, Japan has had to carry on extensive research to overcome the handicap of having no domestic bauxite resources.

Some aluminum companies are now taking up magnesium output along with the primary magnesium producers, some of whom use German patents. Japan's magnesium raw material basis is considerably better than for aluminum since adequate quantities of magnesite are available. At first sea water was used, but now magnesite from Manchuria and Korea is the principal raw material. Man-

(Please turn to page 95)

Petroleum's Past, Present and Future

ROBERT P. RUSSELL *Executive Vice President, Standard Oil Development Co.*

Chem. & Met. INTERPRETATION

At a dinner sponsored by the Junior Chemical Engineers of New York during the Chemical Exposition, the author gave this remarkably comprehensive review of the oil industry. It contrasts petroleum, from a tonnage basis, with some of the other industries so often regarded as outstanding examples of American mass production methods. Chemical engineers will be interested in seeing how favorably this great chemical process industry compares with those in which mechanical operations largely predominate. The answer is found in the former's dependence upon research and engineering development.—*Editors.*

In trying to make a guess as to the position which the petroleum industry may be in following the war it seems simplest first to take a look at the status of the industry today, then to take a brief backward glance and from these two vantage points attempt to take the look ahead.

The petroleum industry in the United States in 1941 will have refined about 1,400,000,000 bbl. of crude oil which is at the rate of about 200 million tons per year. About 44 percent by volume of the crude run to stills will wind up as gasoline, making the 1941 gasoline production approximately 90 million tons. This gasoline will be sold at about $16 per ton as it leaves the refinery. The steel industry, which is generally looked upon as the greatest of the "tonnage" industries in 1941 will make about 84 million tons of steel which will sell at the mill gates for approximately $38 per ton. It is interesting also to compare the petroleum tonnage figures with tonnages of other industries now very much in the limelight. For example, take aluminum which, if hopes are realized may, in 1942 produce 600,000 tons or about 1/150th of our gasoline tonnage.

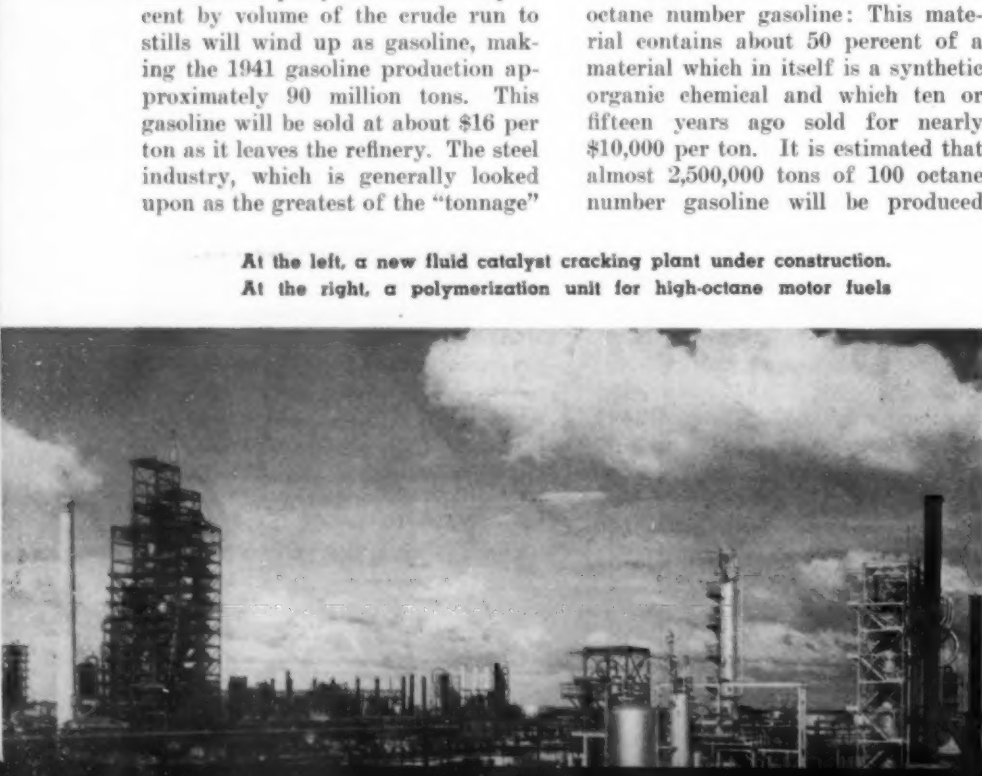
Consider the situation for 100-octane number gasoline: This material contains about 50 percent of a material which in itself is a synthetic organic chemical and which ten or fifteen years ago sold for nearly $10,000 per ton. It is estimated that almost 2,500,000 tons of 100 octane number gasoline will be produced during 1941 and will be sold at the refinery gates for about $50 per ton. If present expansion plans are completed, the industry will be producing at the rate of some 7,000,000 tons per year at the end of 1942.

These tonnage and price figures for petroleum production appear all the more remarkable when one considers that the oil must first be found, that expensive wells must be drilled to secure the crude oil, that this crude must be collected, sent through mammoth pipe line systems into terminals, and then transported by the enormous tanker fleet to the refineries where, finally, it must be refined in equipment of great technical complexity. All this has required capital investment by the industries of the United States of something in the order of $15,000,000,000 and the year-round efforts of some million people whose annual "take-home" is in excess of $1,500,000,000.

The technical complexity of the operations involved in the oil industry is indicated by the fact that the petroleum industry employs a little more than 10 percent of all the research and development workers in the United States. All of the chemical and allied industries together, which normally would be expected to require technical endeavor many times greater, employ less than twice as many people as the oil industry alone. Since 1927 the number of technical people employed in the research and development end of the oil industry has increased seven-fold. During this same period, the chemical and allied industries have increased only three-fold, the rubber industry has expanded to only twice its formal level and the electrical and communications industries have stayed almost constant. (See "Growth of Research" by George Perazich and Philip M. Field, *Chem. & Met.*, Sept. 1939, pp. 523-25.)

In addition to the technical complexity of the oil business itself, it must be realized that petroleum fractions provide the raw materials on

At the left, a new fluid catalyst cracking plant under construction. At the right, a polymerization unit for high-octane motor fuels



which a large chemical industry is based. Alcohols, glycols, ketones, aldehydes, organic acids, plastics, solvents, synthetic rubber, and numerous other products are produced in large volume even today. Under the stimulus of war requirements, this chemical industry is in the process of rapid and important expansion. Although accurate figures are not available, it is likely that the present gross volume of this particular chemical business is well in excess of $100,000,000 a year and it is conceivable that it will reach several times this volume in the course of the next two or three years.

In the refining of oil, rapid advances in the technology of chemical engineering have made it possible to produce increasingly greater yields of more valuable products, and at the same time effect substantial improvements in quality. Twenty years ago gasoline yields on crude were 26 percent, whereas today they are 45 percent. Over this period crude runs have increased four-fold and gasoline production has increased seven-fold. Quality has steadily improved to meet the requirements of high compression motors characterized by improved performance and economy. Accepting ASTM octane number as a measure of anti-knock quality, the average gasoline supplied to the American public in the last 16 years has increased from approximately 50 octane number to 73 octane number today, accompanied by increase in volatility to improve starting and acceleration. In regard to aviation fuels, the development of 100 octane gasolines has given an increase in power of approximately 20 percent over the 87 octane grades in commercial use at present, and an increase of 50 percent over the 70 octane gasolines in use 10 years ago.

Other products have been made available for new economic uses. The increase in distillate oil for household heating, with attendant cleanliness and economy, is evidenced by the fact that over two million oil burners are in use in American homes today. The consumption of heating oils has almost doubled in the last five years. Industry in general owes much to the development of economic, high quality lubricants, and marine shipping has been greatly advanced through the economic use of fuel oil. In the field of oil transportation, the widening use of crude oil pipelines and more recently the development of gasoline pipelines have facilitated the economic distribution of petroleum and its products, which distribution has been aided by increasing efficiency in the ocean transportation of oil by tankers.

Gas manufacturing plant in a large Eastern refinery which supplies the petroleum hydrocarbons used for industrial chemicals

That the benefit of improvement in technique and lowering of cost has been progressively passed on to the consumer is illustrated by the fact that in 1920 the average gasoline price in 50 major American cities was 29.74c. per gal., without taxes. In 1932 it was 13.3c. per gal. Today it is 14.04c. per gal. In the 21-year period the taxes have increased from 0.09c. a gal. to 5.95c. a gal. Thus, lowering the price has been sufficient over the period to absorb the whole tax increase, and pass along a net saving of approximately 10c per gal. to the motorist. In comparison with other commodities—taking 1923 as an index, present prices of gasoline have been reduced by 37 percent since that time. During this same period, the average price of essential commodities (food, clothing, housing, fuel, etc.) decreased by only 15 percent, or by substantially less than the reduction in the cost of gasoline to the public.

WHAT ABOUT THE FUTURE?

What is ahead for the industry and for the public which uses the industry's products? A large number of very large capacity processing units employing most modern catalytic technique are either already installed or will be installed immediately to meet the necessities of the defense program. Within the next two or three years it is expected that catalytic cracking units capable of treating something in the order of 500,000 bbl. per day, will be in operation. These units will be capable of converting about 50 percent of the material charged to the catalyst into 80 motor octane or 90–95 research octane gasoline. These 250,000 bbl. per day (30,000 tons per day) of extremely high octane number gasoline should be considered in the light of present requirements for premium grade motor gasoline which for 1941 was approximately 180,000 bbl. per day.

In addition to the catalytic cracking units there is tremendous expansion in such lines as hydroforming, alkylation, isomerization, and others. Thus after the war there will be available tremendous volumes of superior quality motor gasoline constituents which for a time at least would presumably be available for use in automobile engines since aviation gasoline requirements may drop sharply for some period at least following the cessation of hostilities. If these superior quality materials do go into motor gasolines, automobile engines designed to take full advantage of them could be improved to give economy 50 percent better than that now realized, or power output from 70 to 100 percent greater than is now obtained. After the war tremendous quantities of both aliphatic and aromatic chemicals can be made from the petroleum fractions which will be produced from the installed capacity of these new processes.

With the tremendous increase in utilization of the newer and more intricate catalytic operations, with the tremendous expansion in chemicals produced from petroleum, the petroleum industry which already has been a tremendous user of technical manpower, probably will be one of the major (if not the most important) users of the chemists, chemical engineers, physicists, graduated from our technical institutions.

A Work-Week Plan for Chemical Industry

ROBERT R. LYMAN *The Gray Chemical Co., Roulette, Pa.*

DONALD F. OTHMER *Polytechnic Institute of Brooklyn*

Chem. & Met. INTERPRETATION

With the labor situation becoming steadily more complicated by federal and state laws, and in view of Washington's call for doubled and quadrupled production of war materials the Gray system of scheduling continuous shift work is now worth special consideration. This progressive rotation system for four shifts on a 32-hour cycle and a 168-hour work week has stood the test of four years continuous use and comparison by actual operation with numerous other schemes. The authors state that none approach it in advantages —*Editors.*

A WORKING schedule for seven day, full-time operation of a factory which provides exactly the same conditions for all workers and gives each man five full days of 24 hours off every week has been in successful practice for over four years at the Gray Chemical Co., a well integrated, modern wood distillation plant manufacturing charcoal, refined acetic acid, various grades of methanol, activated carbon, and rough and finished lumber. The novel plan is really based on the substitution of new time units for the usual ones: instead of a 24-hour day, a 32-hour cycle (four 8 hour shifts); instead of a seven-day week, a four-day rotation; and instead of a calendar month, four weeks (28 days of seven rotations) which period acts as a common denominator of days, shifts, cycles and weeks.

168 WORK-WEEK

In operations requiring 168 hours of work per week, scheduling is usually done with four operators, one of whom must always be at the post. On equal division of time, each worker must spend one quarter or 42 hours per week. The problem is to allot time to treat fairly the four men and have the minimum disadvantages in changing schedules. Habits, outside activities, sleeping considerations, wage-hour laws and many other factors must be considered.

The Gray plan of progressive-rotation follows the simplest possible pattern. A man works eight hours, is off 24 hours and repeats indefinitely without change. Thus out of 32 hours, A is on eight, off 24 and tends the post one quarter of the time. B takes over at the end of A's shift and then is also always on eight hours and off 24. C follows B identically and D always follows C to complete the cycle. There are *never* any "shift changes"; every man's lot is always identical; and they all "progress" and "rotate" consecutively.

Since there are three shifts of eight hours per day and four of these in the four-man cycle, at the end of four days the rotation is complete and every man starts his shifts at the same hour as he did the first day; and each man has worked each of the three shifts. Unfortunately, however, the days of the calendar week are seven; and four-day rotations and seven-day weeks will not end together oftener than every 28 days.

FEATURES OF GRAY PLAN

1. **Every man always has at least 5 full days off every week.**
2. **No relief men are required.**
3. **Every man always has three out of four Sundays off for church, and three out of four of every other weekly recurring times.**
4. **No long shifts on or short periods off and no weekly change of shifts with accompanying disruption of sleeping habits, barely acquired from last change.**
5. **Every man may have off at least half of the day time everyday; and desirable sleeping time every night.**
6. **The simpliest possible pattern; no printed schedules necessary.**
7. **Overtime reduced to theoretical minimum and bookkeeping minimized.**
8. **Same men always working together every day.**
9. **Supervisors see every man at least once every four days.**
10. **No man ever works over 8 hours in any calendar day or consecutive 32 hours.**

THE PATTERN

The pattern is illustrated by the chart where the time *on* duty of each man is indicated by the corresponding letter (e.g. A is indicated in boldface). The other letters indicate that the other men are taking their turns and that A is *off* duty. It is assumed in this case that the week begins at 12 midnight Sunday morning. The eight-hour shifts run from 12 midnight to 8 a.m., from 8 a.m. to 4 p.m., and from 4 p.m. to 12 midnight. B follows the same schedule one day later; C, two days later, and D, three days later; or putting it differently, A follows the schedule that B worked the preceding week, that C worked two weeks previously, and that D worked three weeks previously. Regardless of starting time, every man has had the same treatment within four weeks, and will have the same pay. For companies using a four-week month or "13-period year" this is a considerable additional advantage if synchronized thereto. Furthermore, each man will always have three out of four weekly recurring hours off, such as church time, union meeting hour, night school class, etc. Because of the length of time off, it has been found simple in an emergency for one of the partners to work part or all of a man's shift if he must be absent, and this without working a hardship on the substitute.

A major advantage discovered is that the several men in a department in a larger plant, or the several departments of a small plant having

Sample Shift Schedule of Gray Plan

On Off	1st. Week							2nd. Week							3rd. Week							4th. Week						
	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
Mdt.—8 AM....	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
8 AM—4 PM....	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C
4 PM—Mdt.....	C	D	A	B	C	D	A*	B	C	D	A	B	C	D*	A	B	C	D	A	B	C*	D	A	B	C	D	B*	A

The time of shift changes may be adjusted to best suit conditions.
* This shift represents the sixth or "overtime" shift in this particular arrangement which each man has one week in four. Other arrangements give two weeks without overtime and two weeks with overtime adjustable in any desired way so that sum is eight hours.

only one man per shift at each post, always have the same team of men operating at any one time; and this group of men working always together, build up a better spirit of cooperation than if the group is continually broken up by non-uniform shift changes. Of equal importance is the fact that the supervisor, working only during the day time, will see every man at least once in four days, while in schedules changing shifts weekly, it may be several weeks before a supervisor sees certain men.

FIVE SHIFTS PER WEEK

One important consideration is the requirement of the Wage-Hour Law that all time over 40 hours in any week is paid as overtime. Any schedule giving one man less than 40 hours increases the overtime to another, although eight hours overtime must be paid every week. No matter when *this* schedule starts every man will work at least five full shifts or 40 hours. In the diagram, A works six shifts or 48 hours the first week and thus receives all of the overtime, while each of his partners work only the regular 40 hours; but each receives, one week in four, the full eight hours overtime. There could be nothing simpler since a man either works five or six shifts weekly.

There are no variations of the uniform pattern; but the question *"When does it start"* is important. The diagram indicates the calendar week beginning and ending with a man coming to work and one leaving. If the plant week does not start at midnight Saturday night, or if the shifts do not start at midnight, 8 a.m. and 4 p.m., the program may be moved forward any desired number of hours to give different overtime arrangements, (always two weeks without overtime, and the other two weeks dividing eight hours, as 4-4, 5-3, 6-2, 7-1, or 8-0.)

Gray employees prefer to start at noon, 8 p.m., and 4 a.m., as this always gives them at least half of the daylight off every day (morning or afternoon), for their own pursuits; and divides up the night in such a way that it is easy to get to sleep. Furthermore, all shift workers can have their noon dinner at home at about the normal time. Also, the day-working supervisors contacts two sets of shift workers each day.

The plan was first used in the chemical plant, where one man handles his post without relief throughout his shift and eats his lunch without leaving and on company time. In some cases it is desirable that he stop his work to eat. By allowing 23 minutes off per shift for lunch, however, a man will average 40 hours a week. A longer lunch period may be worked out to minimize overtime, if the schedule is used wherein a man works five and one-half shifts for two consecutive weeks (or really 11 shifts within the two calendar weeks) and then two weeks of five shifts each. If the eight extra hours are divided into rest periods, there results 11 such periods of 43.64 minutes. Streamlining this to a 45 minute lunch period will give two work weeks of $39\frac{7}{8}$ hours each and two work weeks of $36\frac{1}{4}$ hours each, with no overtime to be paid. The simplest system, with one hour off for lunch, would reduce time to seven hours of pay for each trick; or $38\frac{1}{2}$ hours for each of two weeks, and 35 hours for the other two.

A *three* man combination working nine-hour shifts with one hour off for lunch and coming back in 18 hours, instead of 24, will work a 27-hour cycle, instead of 32, which returns to starting point in nine weeks. It averages a little less than 50 hours a week.

The work-week plan has been operating successfully for several years at the Roulette, Pa., plant of the Gray Chemical Co.

Aluminum-Magnesium Alloys

L. J. BENSON AND R. B. MEARS *Research Laboratories, Aluminum Company of America, New Kensington, Pa.*

Chem. & Met. INTERPRETATION

In recent years many alloys have come into prominence for the construction of chemical engineering equipment, among them are the aluminum-base materials containing varying amounts of magnesium. In many cases they have marked resistance to the corrosion of alkalis. Recently, the authors have completed a series of tests which throw additional light on this resistance to chemicals.—*Editors.*

THE WIDESPREAD INCREASE in demand for aluminum in the past 50 years undoubtedly has been realized because of two main factors. The first was Hall's discovery of the electrolytic method for obtaining aluminum by the reduction of aluminum oxide, while the second was the exploitation of the alloying characteristics of the metal itself. The importance of the first discovery cannot be over-estimated since it shortly resulted in a reduction in cost of from $8 to $2 per lb.[1] and, together with other subsequent improvements in manufacture and greatly increased consumption, has resulted in a basic price of about $0.15 per lb. In connection with the second factor, it is of interest to note that more than 30 years ago a statement was made that "it is not improbable that the alloy producing capacity of aluminum may eventually prove its most valuable characteristic."[2] As a matter of fact, this characteristic has resulted in the production of alloys suitable for use in the chemical industry, in structural applications, as well as in the expanding aircraft industry.

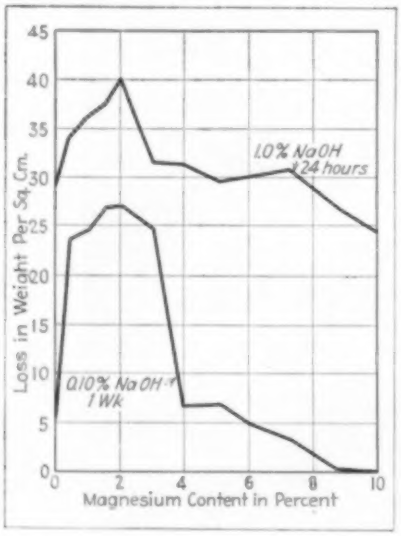


Fig. 1—Effect of change in magnesium content on rates of attack of Al-Mg alloys in 0.1 and 1 percent caustic at 31 deg. C.

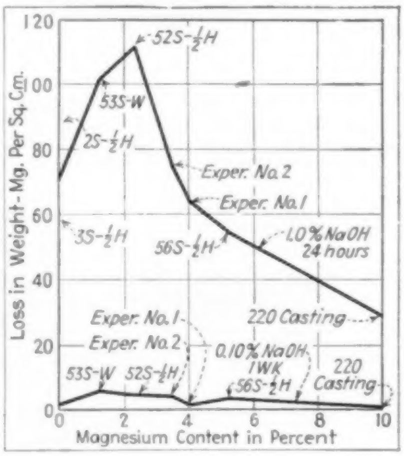
Among the alloys that have come into prominence during the past few years are aluminum-base alloys containing varying amounts of magnesium. These alloys not only possess the characteristics of lightness in weight inherent in both metals, but also exhibit in many cases marked resistance to the action of alkaline media.[5,8,11] The authors have shown in a recent publication[7] that small additions of magnesium to aluminum do not result in improved resistance to attack by sodium carbonate solutions but that alloys containing 4 percent or more magnesium are much more resistant to attack in such solutions.

More recently, comparisons of the resistance of the same alloys to corrosion by solutions of sodium hydroxide have also been made. The results are substantially in agreement with those obtained with the sodium carbonate solutions, inasmuch as alloys containing less than 3 percent magnesium showed less resistance than did certain aluminum alloys containing no magnesium, while alloys containing more than 4 percent magnesium exhibited improved resistance to corrosion. It was also found that alloys of aluminum containing more than 3 percent magnesium were less resistant to solutions of sulphuric acid than were those containing lesser amounts of magnesium. In other words, alloys of aluminum containing more than 3 percent magnesium appear to exhibit, in a measure, the corrosion characteristics of magnesium itself. In alkaline solutions where magnesium itself is resistant, they showed improved resistance, while in acid solutions where magnesium is readily attacked, they showed lowered resistance.

METHOD OF TEST

The investigation was conducted in a manner similar to that previously described.[7] Alloys containing 0.00, 0.46, 1.01, 1.54, 2.05, 3.08, 3.99, 5.17, 6.10, 7.25, 8.77, and 10.13 percent magnesium were used in tests made with 0.001, 0.010, 0.10, 1.00 and 10.0 percent solutions of sodium hydroxide and sulphuric acid. The aluminum base used in making these alloys was 99.984 percent pure, containing 0.004 percent silicon, 0.008 percent iron, and 0.004 percent copper, while sublimed magnesium containing 0.01 percent aluminum and 0.01 percent Group 2 metals was used for the magnesium additions.

Fig. 2—Effect of change in magnesium content on rates of attack of commercial and experimental alloys exposed in 0.1 and 1 percent caustic at 31 deg. C.



The alloy ingots were given a homogenizing anneal, hot rolled to 0.64 cm., given an intermediate anneal, and then cold rolled to 0.064 cm. thickness. The sheet material then was stored at room temperature for six years before

Resist Attack

being used in this test. Duplicate specimens, 1.9 x 6.4 cm., of the alloys, were cut from the sheet and were degreased twice in carbon tetrachloride immediately before exposure to the action of the sodium hydroxide or sulphuric acid solutions. Tests were also made with a number of commercial and experimental wrought aluminum alloys.

C.p. sodium hydroxide and sulphuric acid (sp. gr. 1.84) and distilled water were employed in making the solutions used in this investigation. In order to prevent possible contamination, the solutions were not exposed to laboratory air for any extended period of time prior to use in the test.

The test was conducted by partially immersing the specimens in 100 cc. volumes of the media contained in Pyrex glass beakers which were kept in desiccators in an air chamber maintained at 31 deg. ± 1 deg. C. A stream of purified air (maintained at 25 cc. per min.) was drawn through the desiccators during the time the test was under way. This air was purified by "washing" with 10 percent (by weight) sulphuric acid and 10 percent sodium hydroxide solutions. Each desiccator contained a small amount of distilled

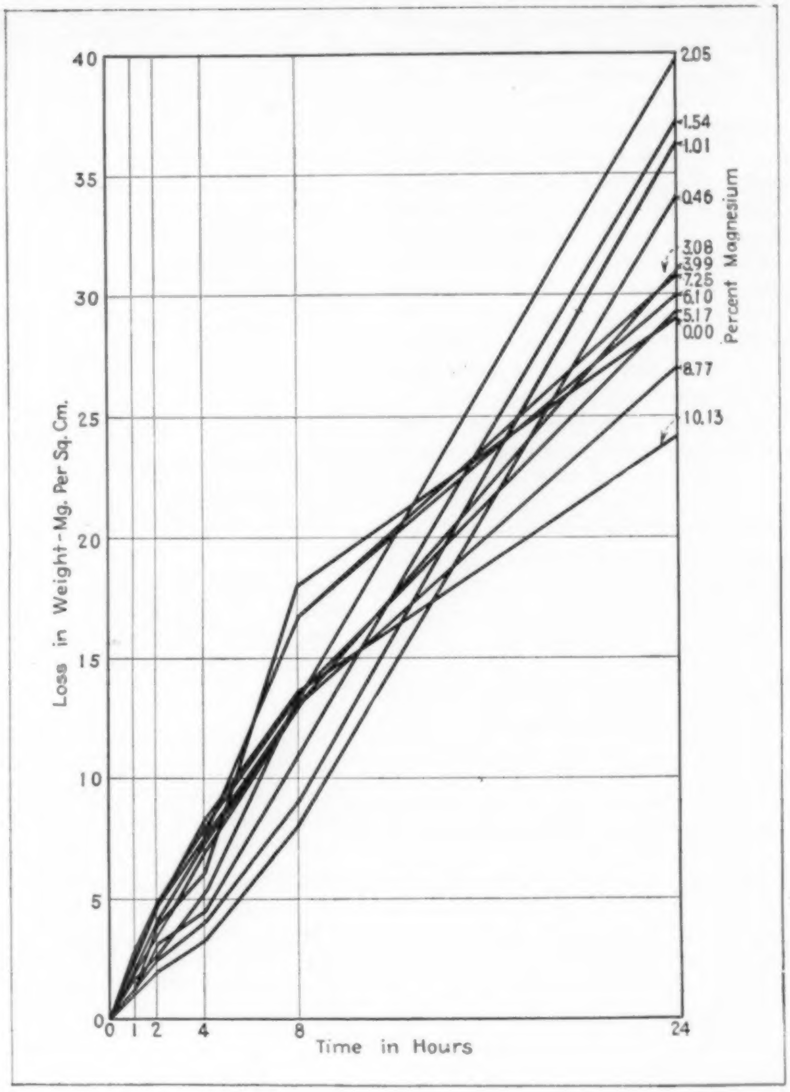


Fig. 3—Effect of time of exposure on rates of attack of Al-Mg alloys by 1 percent caustic at 31 deg. C.

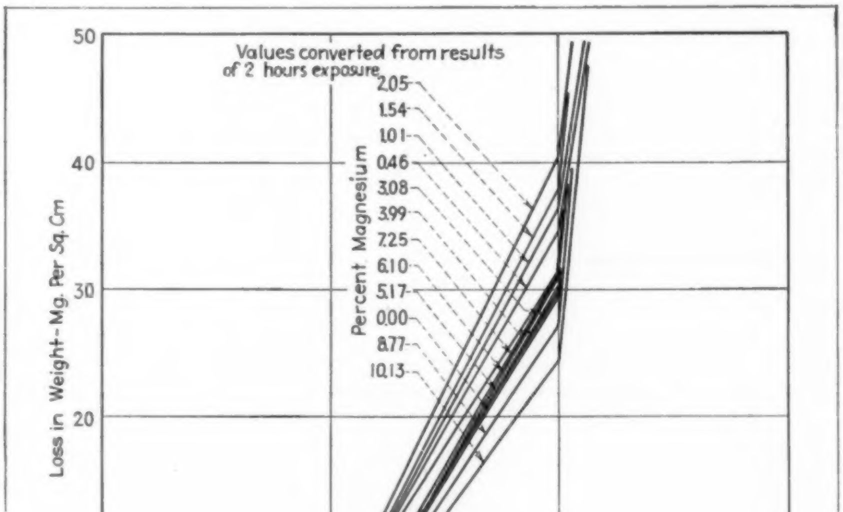


Fig. 4—Rates of attack on Al-Mg alloy specimens exposed for 24 hr. in caustic at 31 deg. C.

water to prevent evaporation of the test solutions.

The specimens were weighed before exposure and after certain preselected intervals, and the tests were terminated with the different solutions as follows: 0.01 percent sulphuric acid after one week; 0.1, 1.0, and 10.0 percent sulphuric acid solutions after 24 hr.; 0.001, 0.01, and 0.1 percent sodium hydroxide solutions after one week; 1.0 percent sodium hydroxide after 24 hr.; and 10.0 percent sodium hydroxide after 2 hr.

RESULTS

The results of tests with the sodium hydroxide solutions are shown in Fig. 1, 2, 3, and 4. Fig. 1 shows that the amount of attack with a group of special alloys in 0.1 percent sodium hydroxide for one week, and in 1 percent sodium hydroxide for 24 hr., is appreciably higher with alloys containing between 0.49 and 3.08 percent magnesium than with alloys containing greater amounts of magnesium, or even with aluminum containing no magnesium; while alloys containing 9 or 10 percent mag-

nesium are definitely less attacked than pure aluminum. In Fig. 2 are shown the results obtained in the same solutions with a series of commercial and experimental alloys. It is of interest to note that the maximum attack again was produced on alloys containing less than 4 percent magnesium, and that the alloy containing 10 percent magnesium was less attacked than the alloys which did not contain any magnesium. The results obtained in the other solutions are not plotted, since with the more dilute solutions the losses were not appreciable, and with the 10 percent sodium hydroxide solution, specimens of all of the different compositions corroded at nearly the same rate. Exposure in the 0.001 and 0.01 percent sodium hydroxide solutions resulted either in an irridescent staining or in the formation of a dull brown or black film. In the other solutions the attack on the alloys containing 4 percent or more magnesium was of a uniform etching type. With certain of the other alloys of lower magnesium content, a non-uniform type of attack had occurred, resulting in some cases in actual perforation.

In Fig. 3 is shown the relationship between duration of exposure and rate of attack in the 1 percent solution of sodium hydroxide at 31 deg. C. For alloys containing up to 7.25 percent magnesium the rate of attack is substantially constant with time, but for the alloys containing 8.8 and 10 percent magnesium it appears that the rate of attack falls off with increasing duration of exposure.

The effect of increased concentration is clearly shown in Fig. 4. No appreciable weight losses were obtained in the 0.001 and 0.01 percent solutions. With the 0.1, 1, and 10 percent solutions a very marked acceleration of attack resulted.

SULPHURIC ACID

In the exposure to sulphuric acid solutions, the results varied characteristically from those obtained with the sodium carbonate and sodium hydroxide solutions. The decreased resistance to the acidic media with increasing amounts of magnesium is clearly shown in Fig. 5, 6, and 7. Fig. 5 shows that the attack in 1 or 10 percent sulphuric acid solutions does not assume appreciable proportions until a magnesium content in excess of 3 percent is reached. From Fig. 6 it can be seen that the stimulating action of magnesium is not appreciable until sulphuric acid concentrations of 1 percent or above have been attained. In the 1 percent solution of sulphuric acid, the relation of duration of attack and rate of attack is shown in Fig. 7. Here again it can be seen that only when the magnesium content becomes greater than 3 percent does the attack of the sulphuric acid solution become appreciable. The 0.001 and 0.01 percent solutions produced only a non-uniform staining on all specimens, while in the 0.1, 1, and 10 percent solutions, the attack was of a uniform etching type.

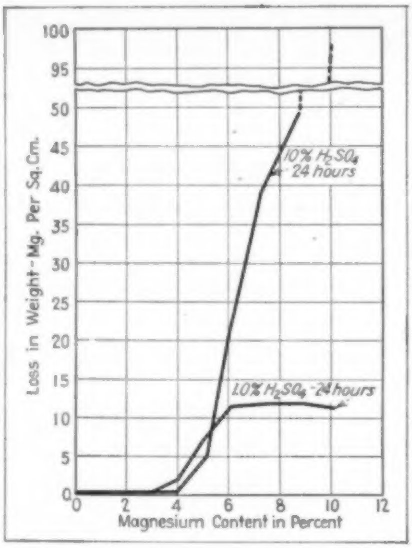


Fig. 5—Effect of change in magnesium content on rates of attack of Al-Mg alloys exposed in 1 and 10 percent sulphuric acid for 24 hr. at 31 deg. C.

SULPHURIC ACID INHIBITED

Another test was made with three of the commercial and experimental alloys to determine their behavior in solutions of sulphuric acid "inhibited" with sodium dichromate. Since sulphuric acid solutions are commonly used for dissolving flux residues from welded aluminum articles, some contamination by chlorides (from the flux residues) naturally is encountered. Consequently, this test also included sulphuric acid solutions containing a definite amount of chlorides (as sodium chloride) with and without an addition of sodium dichromate. The results are given in Table I and show:

1. With increasing magnesium content a decrease in corrosion resistance resulted, which was in agreement with the results previously discussed.

2. The addition of chlorides as sodium chloride had no appreciable effect upon the corrosiveness of the

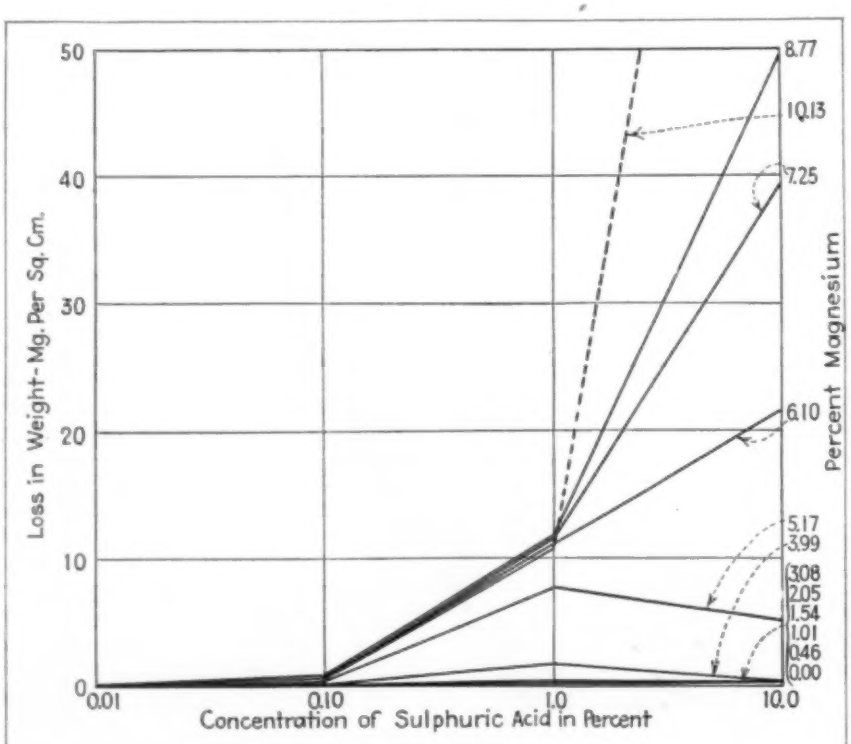


Fig. 6—Rates of attack on Al-Mg alloys exposed 24 hr. in sulphuric acid at 31 deg. C. 10.13 Mg alloy entirely dissolved in 10 percent acid in 24 hr.

sulphuric acid solution, as measured by weight changes.

3. The addition of sodium dichromate served as an "accelerator" of attack rather than an inhibitor. When added to the sulphuric acid solution, the attack was tripled; while with the sulphuric acid and sodium chloride solution the attack was between 25 and 30 times as great.

The stimulating action of dichromate additions is in agreement with results obtained by Evans with chromic-sulphuric acid solutions on iron[3], as well as with those obtained by other investigators.[9,10] The attack on the aluminum in the sulphuric acid, the sulphuric acid and sodium dichromate, and the sulphuric acid plus sodium chloride solutions was of a uniform etching type. However, in the sulphuric acid-sodium chloride-sodium dichromate solution, the attack was largely of a severe, nonuniformly distributed pitting type. Similar severe pitting sometimes results when insufficient additions of inhibitor are made to chloride solutions to which iron, steel, zinc, and aluminum specimens are exposed.[9]

DISCUSSION

The reason for the rather abrupt change in the rates of solution of aluminum alloys containing less than 3 or 4 percent magnesium as compared with rates for alloys of higher magnesium contents is not definitely known. Microscopic examinations of the specimens indicated that particles of the aluminum-magnesium constituent were present in those alloys containing more than about 2 percent magnesium. The change in behavior, therefore, does not quite coincide with the apparent magnesium solubility limit. Under equilibrium conditions the solubility of magnesium in aluminum at room temperature is evidently rather low (under 0.5 percent)[4] so that finely divided particles of the aluminum-magnesium constituent may have been present in alloys containing even less than 2 percent magnesium, although this could not be verified microscopically.

It is interesting to note that the alloys of higher magnesium contents were definitely not single phase materials, although they were much more resistant to attack. Evidently, if corrosion in alkaline solutions is electrochemical in nature, local cell action was not stimulated by the presence of constituent particles.

PROTECTIVE FILM

Probably the reason that the alloys of higher magnesium contents are less attacked in alkaline solutions is because of the protective nature of the film which is formed. It has also been noted that aluminum alloys containing substantial additions of magnesium are definitely more resistant to the action of alkaline soap solutions or solutions of ammonium hydroxide than are aluminum alloys of lower magnesium content. This superiority of the aluminum-magnesium alloys is exhibited in both hot and cold solutions. Thus, it appears that, in general, where resistance to alkaline environments is desired the aluminum alloys containing more than about 4 percent magnesium should be given consideration.

In contrast to this, the aluminum alloys containing more than about 3 percent magnesium are definitely more rapidly attacked by acid solutions than are alloys of lower magnesium content. This has been confirmed under actual service conditions where alloys such as No. 43 or No. 406 have withstood the action of dilute sulphuric or hot citric acid solutions much better than have alloys B214 (3.8% Mg, 1.8% Si, balance Al) or 214 (3.8% Mg, balance Al).

CONCLUSIONS

1. In tests conducted at 31 deg. C the rate of attack becomes appreciable only in concentrations of 0.1 percent and above of sodium hydroxide or sulphuric acid on high purity aluminum, high purity aluminum base alloys containing magnesium, and on certain aluminum-magnesium alloys of commercial purity.

2. Aluminum-magesium alloys containing 4 percent and more magnesium are equally or more resistant to the action of 0.1 and 1 percent solutions of sodium hydroxide than are alloys containing lesser amounts of magnesium. This effect was not evident in the 10 percent sodium hydroxide solution.

3. Alloys containing 4 percent and more magnesium are less resistant to the action of 0.1, 1, and 10 percent sulphuric acid solutions than are alloys having lower magnesium contents.

4. An addition of sodium dichromate to a 10 percent sulphuric acid solution accelerated the attack somewhat, while a similar addition to a sulphuric acid-sodium chloride solution served to produce a very material acceleration of attack.

Fig. 7—Effect of time of exposure on rates of attack of Al-Mg alloys by 1 percent sulphuric acid at 31 deg. C.

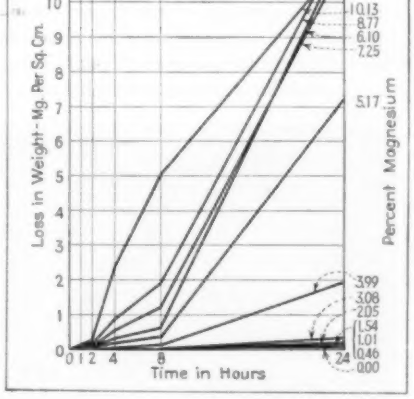


Table I—Effect of addition of Sodium Dichromate to Sulphuric Acid Solutions in Contact with 2S, 52S, and 56S Aluminum Alloys

Alloy	Nominal magnesium content, %	Loss, mg./sq.cm.			
		10% H_2SO_4	10% H_2SO_4 +1.0% $Na_2Cr_2O_7$	10% H_2SO_4 +10 g/1 NaCl	10% H_2SO_4 +10 g/1 NaCl + 1.0% $Na_2Cr_2O_7$
2S	0.0	0.21	0.69	0.24	6.94
52S	2.5	0.33	0.78	0.36	8.12
56S	5.2	0.75	1.98	0.76	8.68

Specimens exposed for 24 hr. at room temperature. Values given above are averages from 3 specimens, 0.16 cm. x 2.5 cm. x 10.0 cm. These specimens were immersed to a depth of about 5.0 cm.

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How Friction and Forced Draft Affect Stratification in Kilns and Dryers

EDWARD LEDOUX *Civil Engineer, Latrobe, Pa.*

Chem. & Met. INTERPRETATION

This article and one which preceded it (*Chem. & Met.*, Oct. 1941, pp. 83–85) are the result of an extensive study which the author conducted for the purpose of determining the best means of improving heat distribution in convection-heated kilns and dryers. The earlier article studied the stratification of gases in such equipment under the simplifying assumption of frictionless gas flow in an empty, natural-draft tunnel drier. This article shows effects on stratification of gas friction, of loading and of forced draft, as well as the combination of natural and forced draft, and draws a number of conclusions regarding the means for eliminating or minimizing stratification and the bad effects that follow from such a condition.—*Editors.*

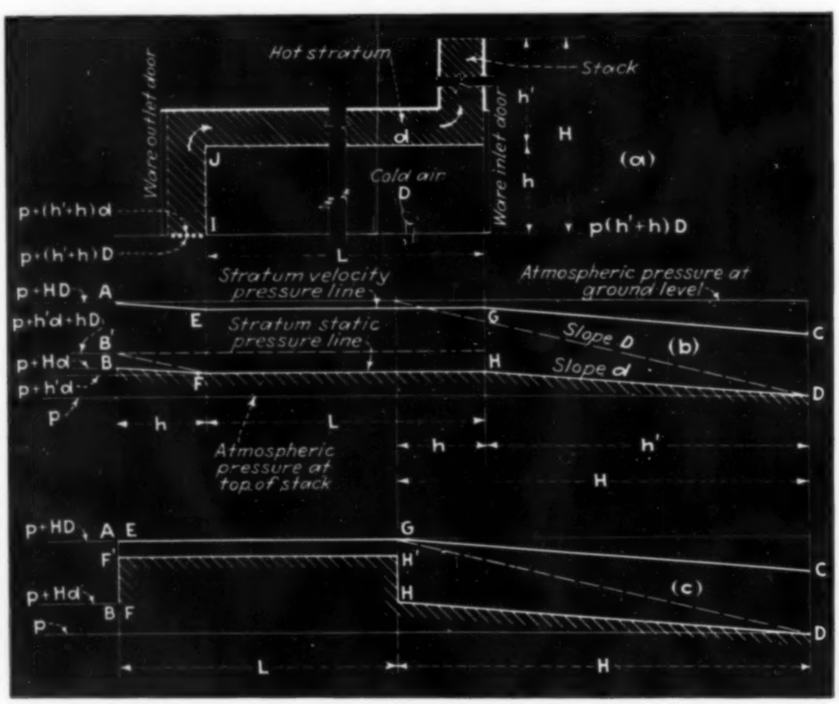
Successful operation of such widely diversified types of equipment as chemical product furnaces, tunnel and periodic dryers, kilns, metallurgical furnaces and recuperators, depends upon uniformity of temperature or the controlled distribution of heat to the material undergoing treatment. This applies with equal force to all sorts of equipment in which heat is transferred by convection. In such equipment stratification of the heating gases often occurs and upsets the design calculations. It was, therefore, the author's purpose in carrying out the study which resulted in this, and an earlier article (*Chem. & Met.*, Oct. 1941, pp. 83-85), to examine both causes and means of preventing stratification and the ways whereby performance of the equipment could be improved.

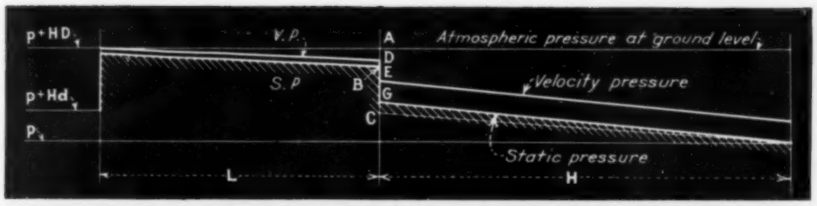
In the earlier article the situation was studied under the simplest conditions, assuming no friction of the gases, an empty dryer, and natural draft operation only. The present article removes these restrictions and examines the effects of friction, of loading, and of the use of forced draft, either alone or as a supplement to natural draft.

Initial operation of a natural draft dryer finds it filled with cold air which during operation is eliminated, all or in part, as more and more hot air is passed through it. Fig. 1*a* shows the cross section of the dryer studied in the earlier article. The hot air is of density d, and the cold air of density D. Atmospheric pressure at the top of the stack is taken as p, the overall height of the stack as H, the height of the cold stratum in the dryer as h, and the distance from the stack top to the bottom of the hot stratum as h'. Hence, atmospheric pressure at the ground outside the dryer and under the heating coils is $p + (h' + h)D$ or, since $H = h' + h$, it may be written $p + HD$. Similarly, inside the dryer above the coils, the pressure is $p + (h' + h)d = p + Hd$.

Frictionless flow is of course purely theoretical and in practice the total pressure difference at the dryer inlet must not only create the outlet velocity but also overcome the friction resulting from the flow so that the same pressure difference will supply a smaller draft than that theoretically possible. This is expressed by $(p + HD) - (p + Hd) = dv^2/2g + F$ in which the velocity v is smaller than the value of V given in the first article. The quantity F is that part of the total pressure difference available which is not transformed into velocity pressure because it is required to overcome friction. It shows up in the

Fig. 1—Graphical analysis, repeated from the author's first article, showing conditions with respect to static and velocity pressures in a theoretical (frictionless) dryer: (a) cross section of dryer, identifying various points and elevations; (b) pressure diagram at moment of establishing natural draft under frictionless conditions; (c) pressure diagram with cold stratum eliminated under frictionless conditions





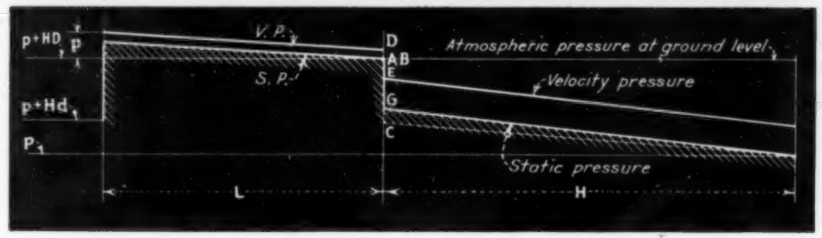


Fig. 2—Pressure diagram showing effect of friction in a natural draft dryer, assuming a constant gas density and no stratification

Fig. 6—Pressure diagram in a combination forced and natural draft dryer, with the total pressure difference increased to the limit

form of additional static pressure in the hot stream. This additional pressure difference decreases as the air travels, of course, since it is used up in overcoming friction due to motion. It is equal to zero at the outlet of the system (top of the stack) because the total friction which has been overcome at that point is F. The friction is a function of the velocity and it is customary to consider its variation as being proportional to the square of the velocity, expressing it as $F = k'v^2$ or $F = kdv^2/2g$. In the latter formula, which features the velocity head, k is the coefficient of resistance of the system. It would be a constant if the square law held for all velocities. Such is not the case, however, and for low velocities the variation is proportional to a smaller power of v, the value of which varies with the system and the velocity.

In any event, on account of friction, the static pressure of the hot stratum at any given point on the separation plane between it and the cold air is increased by the quantity f, which is the friction remaining to be overcome between the point considered and the stack outlet. This extra pressure f of the hot stream is communicated to the cold air below, so that at ground level the static pressure of the latter is $p + h'd + hD + f$. Now, equilibrium requires that the static pressure of the cold air remain constant down the dryer. Since f decreases down the dryer, the hot air stratum must contract. If we call A the internal height of the dryer; x the stratum depth and f the friction remaining to be overcome; and x_0 and f_0 the same quantities immediately to the right of point J (Fig.1a), we have $p + xd + f + (A-x)D = p + x_0d + f_0 + (A-x_0)D$. This expression, which after changing signs reduces to $x = x_0 - (f_0-f)/(D-d)$, shows that the cold air pressure remains constant and also that the decrease in stratum depth, which is proportional to the friction, would be linear for a constant friction loss per foot travelled. The constant ground level pressure of the cold air is $p + h'd + hD + f_0$.

Since F is the total friction of the system, the suction at point I (Fig. 1a) will be caused by the difference $(p + h'd + hD + f_0) - (p + h'd + hd + F)$, or $(p + h'd + hD) - (p + h'd + hd) - (F - f_0)$. This is compared with the difference of $(p + h'd + hD) - (p + h'd + hd)$ which would hold in the case of frictionless flow. In other words, friction will in this respect retard the evacuation of the cold air. However, the difference $F-f_0$ is very small and this effect is negligible.

On the other hand, the pressure of the inside cold air is higher than in the case of no friction by the quantity f_0, so the difference with respect to the outside is reduced by the same amount and the inrush of cold air from the outside will be less.

Moreover, the friction encountered in the system is composed of two distinct factors—the friction against the walls and ceiling of the dryer and that against the cold air. Since the walls and ceiling are immovable, the first item is just a plain loss. In the second case, however, the cold air is free to move under the force of reaction set up against the friction and this circumstance gives rise to entrainment of cold air at the stratum limit, favoring the evacuation of the cold air in the dryer. Since the velocity in the hot stratum and therefore the friction decreases as the layer depth increases, it will be seen that the entrainment effect becomes less and less important as the stratum expands.

On the whole, friction will diminish stratification both by reduction of the leakage and by increase of the evacuation.

It will be noted that in the case of natural draft alone, the inside static pressure will always be lower than the outside, since its maximum value is given by $p + Hd + F = p + HD - dv^2/2g$. In other words, with natural draft alone, air will always enter through any possible leaks and every time the doors are opened. This will be seen on Fig. 2 which shows graphically the static and velocity pressure variations for a constant density and no stratification. The slope in the dryer is equal to its coefficient of resistance, while GC is the total resistance of the stack. In the case considered, the velocity pressure in the dryer is a quarter of that in the stack. The drop DE is the friction loss at entrance of the stack, assumed equal to one velocity head ($k = 1$).

It will be noticed, by the way, that the smaller the velocity increase when the air enters the stack, the greater will be the velocity in the dryer; hence the advantage of a large stack, although exaggeration in this respect will render difficult the establishment of the operating draft upon starting.

EFFECT OF WARE

When material to be processed is put into the dryer, it will obstruct the flow of the stratum and, like the baffling mentioned in the first article, will cause a backing-up in front of the ware to an extent determined by the fact that, for all practical purposes, the flow area remains the same through the ware as through the empty dryer. In other words, the back-up ratio will be equal to that of the free areas of flow with and without the ware. This is illustrated in Fig. 3 and expressed by $H/h = S/s$, in which H is the stratum depth before and in the ware, h is the depth when the dryer is empty (depth assumed behind the ware), s is the free area of flow when the dryer is loaded and S is the free area when empty.

The above formula brings out the great importance of reducing s as much as possible by close setting of the ware and reducing to a minimum the free space between the load and the walls and ceiling.

The baffling effect of the ware will cause considerable turbulence in the flow through partial transformation

of velocity pressure into static pressure as the air strikes the ware. The result of this turbulence at the lower limit of the stratum will be a certain amount of mixing with cold air which will to some extent favor diffusion.

DENSITY VARIATION

Previously, we have considered the density of the stratum as remaining constant throughout. In practice, of course, there is a considerable density increase as the air travels on account of heat loss through the walls and ceiling, but principally through heat exchange with, and evaporation from, the ware. The result is a contraction of the hot layer. However, the stratum is limited on three sides by the ceiling and walls of the dryer so that the contraction will occur half vertically (decrease in depth) and half horizontally (decrease in velocity). The weight flow being constant, the velocity and depth at any point are therefore inversely proportional to the square root of the density at that point, as expressed by: $v/v_0 = H/H_0 = (d_0/d)^{1/2}$, in which H_0 and v_0 are the depth and velocity at the point where the density is d_0 (i.e., conditions at the inlet to the ware, for instance). For example, if before the ware the depth is 48 in. and the air is dry at 210 deg. F. (density = 0.059), a temperature drop down to 110 deg. and a humidification to 50 percent relative humidity (density = 0.068) will reduce the depth to $48(5.9/6.8)^{1/2} =$ 44.5 in.

This contraction caused by density variation is cumulative with that caused by friction.

CONSEQUENCES OF STRATIFICATION

It is well known that the temperature and humidity variations of the air and ware in a dryer are controlled by the flow of air per pound of ware present in the dryer, and the rate of output of the ware. Supposing now that only half the ware is in the stratum, then only half of it will be treated and the output per pound present in the stratum will be the same as in the design calculations which assume that the air fills the dryer completely. However, the amount of air in the stratum will be that provided in the calculations for the entire load in the dryer so that the quantity per pound of ware present in the stratum will be double. Furthermore, the velocity of the air will be twice that intended and the coefficients of transfer greatly increased. The result will be much more rapid drying in the upper part of the dryer than called for by the design and the ware in this part will be overdried, while the temperature drop of the air will be increased. Hence, the contraction of the stratum on account of density variation will be greater than would be expected from the design figures.

In a properly designed dryer, the air outlet conditions are determined so that the dew point will be lower than the temperature of the ware as it enters the dryer (usually atmospheric temperature). The purpose of this point of design, of course, is to avoid condensation which reduces considerably both the drying capacity and efficiency of the process, while it may also be harmful to the ware.

Now, in the case where stratification occurs, the outlet temperature of the air will be lower than desired and the air may reach saturation with formation of fog. Furthermore, even if saturation is not reached, the fact that evaporation from the ware is greater than called for in the design is likely to raise the dew point above the temperature of the ware and cause condensation. The extent to which fog and condensation will occur depends upon the dew point margin adopted in the design and the degree of stratification.

The foregoing discussion brings out the fact that stratification will not only leave part of the ware untreated but also will cause wasteful and inefficient processing of the treated part since it will be unnecessarily overdried, while fog and condensation are made probable.

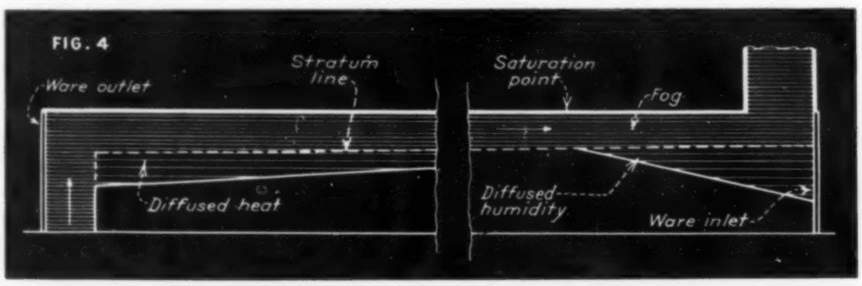
STRATIFICATION OF HUMIDITY

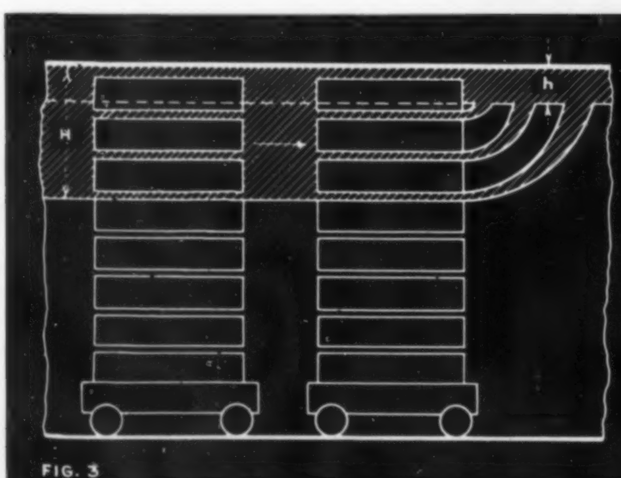
Disregarding diffusion, the humidity picked up by the stratum will remain in it for the same reason that hot air stratifies, that is, because it is lighter than the cold air below. Diffusion will occur, however, and

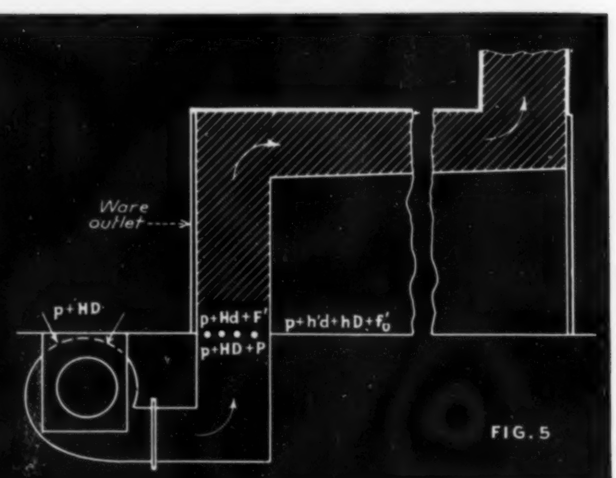
Fig. 3—Effect of ware in dryer on backing-up of hot stratum

Fig. 4—How heat and humidity diffuse in a tunnel dryer

Fig. 5—Pressure differences in a dryer using forced plus natural draft







instead of an abrupt change in humidity at the stratum limit, the variation will be more or less gradual according to the rapidity of the counterflows. In any case, since the rate of diffusion increases with the vapor pressure, the depth of the humid stratum will increase down the dryer because of the gradual increase in vapor pressure in that direction. If fog forms, either on account of stratification or because of faulty design, the cloud will collect against the ceiling and increase in depth.

Since the temperature of the stratum decreases down the dryer, it will be noted that diffusion of heat will be more pronounced at the hot end. The effect of diffusion of heat and humidity is shown in Fig. 4.

FORCED DRAFT

When air circulation through the dryer is due to natural draft only, the drying process is very slow because the available velocity head at inlet is limited by the heating temperature. Furthermore a higher pressure cannot be maintained inside than out, a necessary condition to suppress the inrush of cold air through leaks.

The combination natural and forced draft system is shown on Fig. 5; P is the total pressure created by the fan. The pressure at fan intake is atmospheric pressure, i.e., $p + HD$, so that the total pressure under the heater is $p + HD + P$ and the available velocity head is $(p + HD + P) - (p + Hd + F') = dv'^2/2\,g$. The pressure at ground level of the cold air in the dryer is $p + h'd + hD + f'_o$.

Since P controls the velocity head, the flow can be set at will by proper selection of the fan. It must be kept in mind however, that the resistance of the dryer and stack increase at the same time as the velocity head so that the static pressure increases. If the resistance is assumed to vary as the square of the velocity, the available velocity head will vary in direct proportion to the total pressure difference, which is expressed by

$$\frac{(p + HD + P) - (p + Hd + F')}{(p + HD) - (p + Hd + F)} = \frac{dv'^2/2g}{dv^2/2g} = \frac{v'^2}{v^2}$$

Owing to the simultaneous increase in static pressure, there is a limit to the desirable increase in P and as the latter increases, the usefulness of the stack and natural draft decreases. The limit is reached when the static pressure at the entrance to the stack has reached atmospheric pressure, i.e., $p + HD$. Then the stack becomes useless as far as draft is concerned. If the fan pressure is raised above the limit, the stack becomes not only useless but actually detrimental since, without it, the pressure P could supply more flow.

This is illustrated on Fig. 6 in which the total pressure difference of the system shown on Fig. 2 has been raised to the limit of desirability, that is to the extent where B has risen to point A (Fig. 2). The ratio of the limiting available total pressure difference to that with natural draft is equal to AC/BC, (Fig. 2) the value of which is 1.37 in this particular case. It will be seen on Fig. 6 that, with or without stack, the flow would be the same. It will also be observed that, the larger the cross section of the stack, the lower will be point B and the higher will be the limit for P.

In a rationally designed combination forced and natural draft dryer, the ware inlet end will therefore always be below atmospheric pressure to an extent which depends upon the proportion of forced draft used. Consequently, air will leak in under the door at the ware inlet end but not at the outlet. When the ware inlet door is opened, air will rush in until atmospheric pressure is reached and the dryer will therefore operate on forced draft alone. Since the operating pressure of the fan will have increased, less air will be delivered. Conversely, when the ware outlet door is opened, hot air will rush out.

The foregoing discussion shows that stratification, which is caused by the continuous or periodic admission of cold air, can be avoided by use of forced draft alone. When both forced and natural draft are used, stratification can be limited through close setting of the ware, airtight door construction and a loading schedule designed to reduce the number of openings to a minimum. The provision of inlet and outlet locks will of course reduce the amount of cold air admitted, although such a scheme to some extent complicates operation.

OUR ENEMIES

(Continued from page 83)

chukuo follows the U.S.S.R. and Austria as the world's largest magnesite producer, with 13.5 percent of world output in 1936. Production of magnesium started in 1931 in Japan, and is now believed to be around 3,000 to 4,000 tons with an ultimate goal of 17,000 tons a year.

Japan has also been using the Fischer-Tropsch synthetic fuel process. Nipponese long-range plans called for a production of 2 million tons of synthetic fuel in 1941, but probably only one-fourth this amount was actually realized. At the beginning of 1941 there were 21 plants either building or in operation, including 12 in Japan proper, 2 in Sakhalin, 2 in Korea, and 5 in Manchuria. Japan is also an important producer of synthetic fibers, rayon and staple, as well as of plastics, of which 90 percent of the Japanese output is represented by phenolic resins. Japanese dye production is relatively recent, and utilizes many German patents. Output increased by 30 percent in 1939 as compared with 1938, no figures being released for 1940. Quality is often reported to be unsatisfactory for Japanese dyestuffs as well as synthetic fibers.

There has been considerable collaboration of the three Axis powers in the chemical field, at least to the extent that German patents have been made available to them. All three have in common the fact that they have developed their chemical production during the past ten years strictly under government control with a view to military and economic self-sufficiency. This has meant coordinated research and the development of a variety of substitute or alternate materials, some of which will probably be dropped at the end of the war and some of which will undoubtedly be kept and developed further in all countries.

In military production it is significant that aluminum and magnesium output for aircraft and precision instruments was vigorously pushed at an early date by the totalitarian governments in spite of high production costs, thereby giving the Axis certain advantages here. In view of the importance of nitrogen in explosives manufacture, it is also obvious why the Axis powers have built up a synthetic ammonia plant capacity twice that of the rest of the world combined.

SUMMARY

While the above-mentioned factors seem to favor the Axis, the tremendous preponderance of natural raw materials available to non-Axis powers, the United States, and Great Britain as an Empire, and the Soviet Union, if properly developed and applied during a long run war, should more than counterbalance the initial advantages of the Axis powers.

Equipment in the Limelight—II

EDITORIAL STAFF REPORT

Chem. & Met. INTERPRETATION

This article, which is a continuation of one which appeared in our December number, completes our report of new developments which were found by *Chem. & Met.* editors at the Chemical Show in December. In our November issue a 21-page article dealt with developments in new equipment and construction materials for process plants which had been introduced in the two year period since the last Chemical Exposition. Information was secured from the Show exhibitors, as well as many non-exhibitors. However, many other developments were uncovered at the Show, and it is these that the present report seeks to cover.—*Editors.*

CONTINUED from pages 83 to 86 of our December number, this article completes our report on new equipment and construction materials for chemical and process plants exhibited at the Chemical Show in December. The types of equipment covered in the earlier report included those for drying, heating and cooling; dust collecting; filtering; grinding and disintegrating; controlling, regulating and weighing.

Materials of Construction—Among the new developments of American Hard Rubber Co., was an improved hard rubber pail featuring a specially reinforced bottom to avoid distortion after continued use. Another innovation was an improved rotating seal for use on hard rubber centrifugal pumps in place of the conventional stuffing box and packing. A hard rubber sleeve on the shaft, sealed to the shaft by a soft rubber sleeve which also acts as a spring, is forced into liquid-tight engagement with a composition disk supported in the pump casing.

Another improvement shown by American Hard Rubber Co. was a new method of rubber-lining iron pipe to avoid producing a flow-disturbing bump at the end of the pipe. The pipe, after attachment of the flange, is chamfered so that the rubber lining can be brought out of the pipe and turned over the chamfer. The entire face of the flange is then rubber-covered to avoid bending stresses in the flange.

New industrial glassware shown by the Corning Glass Works, in addition to the new forms of Vycor 96 percent silica glass and the new small Corning-Nash Pyrex glass centrifugal pump described in our November Preview, included a glass float for use in unit humidifiers for operating the water control valve, and for other float-valve applications. Another showing was of a recently developed Pyrex glass plug-type valve employing a hollow glass plug to insure easy operation in plant applications.

An important point regarding the present situation in ply-metals employing stainless steel was brought out by the Jessop Steel Co. It was pointed out that the OPM allocation on stainless steel affects only those alloys containing 3 percent or more of chromium. A 20 percent plymetal using 18-8 stainless steel thus contains less than 3 percent of chrome and at present is not subject to allocation.

A new method of constructing chemical stoneware-lined tanks, employing this company's synthetic plastic sheeting, Pyroflex, was shown by Maurice A. Knight. Called Pyroflex Fused-on Tile construction, the new method of lining first coats the inner surface of the steel tank with Pyroflex, then applies the lining tiles to the thermoplastic Pyroflex by heating the Pyroflex with a blow torch and pressing the tiles against the fused surface. After the tile has been placed, the joints are pointed with any suitable corrosion-resisting cement. It is claimed that tile cannot fall out even if the joints let go. Another new development with this company is Pyroflex-impregnated glass fabric which is used for gaskets, for certain lining applications and for drip shields.

Indicative of the trend toward the development of new non-metallic materials of construction was a line of tubing fittings made from Seran, Lucite and Tenite, for use with Dow's Seran tubing, and at present available from Parker Appliance Co. in sizes from ⅛ to ⅝ in. The new fittings employ the Parker standard type of flared joint. This company also exhibited a new high-speed flaring machine for flaring the ends of ferrous and non-ferrous tubing for making up joints on a production basis.

Materials Handling, Power Transmission, Welding—Economy Engineering Co. exhibited an improved platform elevator equipped with extremely shallow base bars and rollers to allow the platform to come close to the floor. In this design the platform comes within 2¼ in. of the floor in the lowest position, compared with a standard height of 6 in. for a machine with 5-in. base wheels. Thus drums and barrels may be readily rolled onto the platform without using a ramp or skid.

Developed in Switzerland and available on the Continent for a number of years, the line of Castolin Eutectic low-temperature welding rods is now being produced in the United States by Eutectic Welding Alloys, Inc. These alloys are designed to operate at temperatures below the melting point of the parent metal. Alloys are available for use with cast iron, nickel, Monel metal, all types of steel including stainless, aluminum, bronze and copper alloys, magnesium and its alloys, and other metals. It is claimed to be possible to make welds which will not initiate electrolytic action; which will match the parent metal in color; which have high tensile strength; decrease warping; and require less preheating.

The Falstrom Co. showed its new barrel lift, a simple device for handling barrels or drums of any size. A two-wheeled truck with mechanism

for attaching to the barrel is rolled up to the barrel as it stands on end. The barrel is then locked to the lift, elevated slightly by tipping the handle back, and moved to its new position.

A simplified type of package elevator was shown by the Lamson Corp. This elevator is readily portable and is adjustable to any operating angle from horizontal to a tilt of 30 deg. It employs a 14-in. continuous belt without belt side guards so that overhanging loads can be handled. Operating at a speed of 70 f.p.m., it requires $\frac{1}{3}$ hp. and can handle loads to 100 lb.

Further evidence of the spread of plastic compositions in industrial applications is the new ABK resinoid wheel now being employed by Rapids Standard Co. for industrial truck applications where a wheel is needed that is both easy on the floor, and proof against organic and dilute mineral acids as well as oils, greases and temperatures to 200 deg. F. In these wheels the tread is formed of canvas-laminated plastic while the web and hub, molded simultaneously, is of plastic reinforced with mascerated canvas.

In addition to new developments in its Redler conveyors, described in our Chemical Show Preview, Stephens-Adamson Mfg. Co. showed several improved members of its line of Sealmaster ball bearings. One new type is a cartridge unit for standard and medium duty, another a non-self-aligning type, permanently sealed and pre-lubricated, with an extended inner ring. A pre- lubricated self-aligning type designed for use as a hangar bearing for screw conveyors was also introduced, and a non-self-aligning type for use on conveyor carrier rolls, return and gravity rolls. New take-up bearings for conveyor head pulleys, mounted in frames for screw adjustment, were also shown.

Several new materials handling developments were exhibited by the Philadelphia Division of Yale & Towne Mfg. Co. Among these was the Midget King electric hoist, available in capacities from $\frac{1}{8}$ to 1 ton. This hoist is light in weight and portable, and is equipped with anti-friction bearings throughout, a motor brake, a load brake, safety limit switch and other features available in larger hoists. A new hydraulic hand-lift truck for heavy loads, a midget fork truck, and an improved hand truck were also exhibited.

Mixing—An improvement now standard on its colloid mills was shown by Chemicolloid Laboratories. This is an air-cooled thrust bearing which has been moved close to the motor and as far away as possible from the mill head. The new design is claimed to be particularly suitable for high temperature applications.

Kent Machine Works exhibited its latest type of motor-driven liquid mixer of the change can type, designed for handling batches up to 135 gal. This large unit has a structural steel column supporting the mixer proper, which can be elevated for clearing the top of the batch can. The mixer arm is counterbalanced. The 3-hp. motor is bolted near the base to keep the center of gravity of the mixer as low as possible.

For use in all kinds of mixing operations where continuous single-pass treatment is not essential, the Premier Mill Corp. has developed a portable mixer available in three sizes, the working principle of which is identical with that of this company's colloid mills. The new mixer is claimed to do more than simple mixing or agitating because all particles in the mixer pass several times through the clearance between the rotor and the stator and are broken down almost to the extent possible with a colloid mill. This company also showed a new 2-in. rotor laboratory colloid mill with $1\frac{1}{2}$ hp. universal motor specially designed for operation at 13,500 r.p.m.

The Asbury fluid impact mill for dispersion and homogenizing applications, described in our May 1940 issue, was shown by the Milton Roy Pump Co. which has now taken over distribution of this mill in the smaller sizes up to a rotor diameter of 9 in. Larger mills, with rotors 12 in. in diameter and above, are now being distributed by Patterson Foundry & Machine Co. This mill employs a horizontal disk rotating at high speed with feed at the center. Material is thrown outward, impacting against suitably arranged ridges or teeth on both the disk and the stator. Discharge is at the periphery. Close clearances are not required in this mill.

Packaging—A new idea for the handling of glass carboy jugs was shown by Carrier-Stephens Co., chemical manufacturers. The new device, which was developed by the company for its own use, is now on the market for the handling of glass containers both of carboy size and of 5-gal. size. It consists of a wire "bird-cage" supporting the bottle in a flexible manner. The weight is said to be 40 lb. less than a regulation carboy box. The device is known as the Steel-X carrier and has been designed for easy stacking of the filled carboys.

A completely automatic capping machine for the application of various types and sizes of screw and pressure caps to containers was shown by Elgin Mfg. Co. The only attention during operation required by this machine is filling of the cap-supply hopper. The caps are automatically sorted and fed. Variable speed is available for handling from 18 to 52 caps per minute, with instant adjustment possible for applying closures varying as much as 30 mm. in diameter. This requires but one setting, without changes to the hopper or chute.

Horix Mfg. Co. showed its new Model HBV18 automatic rotary filling machine for the filling of containers with liquids at speeds up to 125-150 pt. per minute. All parts coming in contact with the liquid are of stainless steel. A variable speed drive pulley permits synchronizing the machine with adjacent equipment. No labor is required except for changing from one size container to another. Safety devices automatically stop the machine in case a defective container comes into position or if a jam occurs in the

conveyor leading either to or from the filler.

Piping, Packing, Valves—Darling Valve & Mfg. Co. has introduced a new line of double-disk parallel-seat gate valves in a variety of materials especially for use in the chemical industry. These valves, known as the Specialloy line, may be produced in any castable alloy. They incorporate a unique revolving disk feature, with the disks free to revolve throughout their entire travel. A simple arrangement of disks and wedges avoids possibility of incorrect assembly or placing in the valve.

An improvement in its line of stainless plug valves was exhibited by the Duriron Co. Formerly, Durimet-body plug valves were fabricated using this alloy for both the body and the plug. It has been found that the combination of a Duriron plug with a Durimet body produces a nonsticking valve which ordinarily does not need lubrication. For special applications a lubricating fitting is readily attached and also a device for loosening stuck plugs.

Among developments introduced since the last Exposition, and shown by the Garlock Packing Co., was the company's new Lattice Braid packing. Every braiding strand passes diagonally through the body, giving a unified structure, braided internally as well as externally. Greater strength, better flexibility, controlled porosity and semi-automatic adjustment to the stuffing box are advantages claimed. Another new product shown was this company's Flange-Jacks, a simple tool for prying apart pipe flanges for the replacement of gaskets without danger to the flanges.

Hills-McCanna Co. exhibited several new versions of the Hills-McCanna Saunders diaphragm valve. One was a motorized valve of Saunders construction, made by Barber-Colman Co. Another was a carbon-body valve made of National Carbon Co.'s Carbate impervious carbon. In the past, standard construction of the Hills-McCanna Saunders valve has been to use a non-rising stem. The valve is now available in a rising-stem type to facilitate judging the degree of opening. Still another version of the valve substitutes a quick-opening handle for the hand-wheel. This operates a steep-angle cam which actuates the diaphragm, permitting opening and closing in 180 deg. of movement of the handle.

An interesting new rotating pressure joint, described as the Packless swing-joint multiple seal, was shown by Packless Metal Products Co. The seal, which can be designed for pressures in the range from full vacuum to 5,000 lb. per sq.in., is formed by a metal cylinder through which the fluid passes, within which is a conical expander loaded by a spring. Several such seals are employed in series. The design intends that only the first seal shall hold the pressure, while succeeding seals are held in reserve. The metal cylinders seal against a graphite-containing composition which is said never to require lubrication.

Pumps—A number of design changes have been incorporated in the Huber pump which, since the last Chemical Exposition, has been taken over by Downingtown Mfg. Co. This pump is now known as the Squeegee type. The pumping element consists of a rubber or synthetic rubber tube held within a casing and progressively compressed from the feed to the discharge point by means of an eccentrically rocked compressor ring. In the improved version the tube is formed exactly to the curvature of the casing. The rocker ring, which was previously free to rotate (although unlikely to do so), is now anchored against rotation by a swinging arm.

Hills-McCanna Co. showed its newly designed Type R proportioning pump for low delivery at high pressure. This low-cost construction employs a walking beam to actuate the two pumping cylinders. The motor oscillates the walking beam which then reciprocates the pistons through a stroke dependent on the adjustment of movable stops on the pistons themselves.

A pneumatically actuated diaphragm pump for the handling of abrasive or corrosive slurries was exhibited for the first time by Oliver United Filters, Inc. Either compressed air or vacuum applied to one side of a floating diaphragm in electrically timed impulses transmits its energy through the diaphragm to the slurry or solution being handled on the other side. All parts coming in contact with the material pumped are protected by rubber or neoprene. Ball-type valves are used to prevent possibility of clogging.

A recent development shown by F. J. Stokes Machine Co. was a solvent stripper designed for use as an auxiliary for its oil-sealed vacuum pumps for certain types of application. This unit employs steam distillation to remove low-boiling solvents and other volatile compounds from the pump sealing oil in cases where the oil contamination cannot be removed by the clarifier customarily supplied.

Among several types of proportioning pump exhibited by Wallace & Tiernan Co., the most recently developed variety was a belt-driven feeder for use where neither water pressure nor electric power is available. It can be operated from any available drive shaft, adjustments being accomplished by means of a hand crank which may be changed while the feeder is in operation. The pump employs a balanced diaphragm, a small valve and hollow shaft being used to trap water at the line pressure behind the diaphragm so that pressure on both sides is equalized to avoid strain.

An interesting type of proportioning pump employing a hydraulically compressed flexible tube as the pump cylinder was exhibited by Wilson Chemical Feeders, Inc., under the name of "Pulsafeeder." A piston designed for accurately regulatable stroke operates in a cylinder, applying pressure through a liquid medium to the walls of a flexible pulsating tube made of rubber, synthetic rubber or other materials. A feature of the design is that the pulsating tube operates under balanced pressure and hence requires no reinforcement.

Reaction and Absorption—An interesting idea for the absorption of gases in liquids was shown in the booth of Air & Refrigeration Corp. In conjunction with one of this com-

pany's capillary air washers for air conditioning, a glass-fiber-packed capillary washer cell was exhibited, having all metal parts covered by anode-deposited rubber. This particular cell was developed for washing air containing small quantities of HCl gas. Owing to the low resistance and high active surface obtainable with such cells, the method would appear to have application in other gas absorption applications.

Several new models of its tantalum hydrochloric acid absorption systems have been developed by Fansteel Metallurgical Corp. These are all intended for producing strong acid from gas containing HCl. Type AK is designed for a dilute gas containing a minimum of 50 percent HCl. Type ARN requires a minimum of 60 percent HCl in the feed gases. Type AL is intended for an 80 percent HCl gas. All of these types have somewhat similar design features. Gas first enters a secondary absorption column, consisting of a water-cooled tantalum tube which receives hot acid of comparatively low strength from the main absorption tower, cools it, and boosts the concentration to the value desired. The gas then enters a packed tower in which most of the absorption takes place. The tower is surmounted by a tantalum condenser which removes part of the heat of absorption and condenses vapors out of the vented gases.

Known as the Reactivator, a new water conditioning system has been introduced by Graver Tank & Mfg. Co. This system purifies water by an improved process of coagulation with upward sludge filtration. Foreign materials, both suspended and in solution, are percipitated and then utilized in successive treatment zones of a single tank. This method of upward filtration is said to remove even the smallest particles and to speed up purification greatly.

One of the features displayed by Metal Glass Products Co. was a new 25-gal. still designed for construction in Monel metal or stainless alloys. The still is jacketed for 60-lb. steam and designed for operation under 26 to 28 in. vacuum. The assembly includes the still body, a packed column, and a condenser and receiver. The condenser is particularly adapted to easy cleaning of the tubes. Tubes, tube sheets and shell are assembled by welding into a single unit. The heads, of a suitable cast metal, are then bolted on to the tube sheet with a simple gasket joint.

Safety and Fire Protection—An improvement in carbon dioxide fire extinguishers first developed by Walter Kidde & Co. for use on its 2-lb. extinguishers has now been adapted to its 4-lb. extinguishers. This is a trigger-type release valve control. Prior to the change in the 4-lb. unit, control was by means of a hand-wheel, making it necessary to use one hand for the valve and the other hand for the nozzle. The new design permits one-hand operation.

In addition to several improved designs of respirators for dust and metal fumes, the Willson Products Co. showed a new two-hour, all-purpose gas mask featuring a molded soft-rubber face piece and an improved timer showing the elapsed time the mask had been used since attaching a new canister. The mask is intended for protection against all industrial gas hazards.

Separation — Several design improvements were evident in the Bar-Nun sifter shown by B. F. Gump Co. This sifter is of the type employing a horizontal screening surface gyrating in a circle. The design has been simplified through substitution of a V-belt drive for the gear drive formerly used. The sifter box is now carried on vertical rods supported at either end on ball-bearing universal joints which are permanently lubricated. In the older design, the joints operated in a bath of oil and presented a sealing problem.

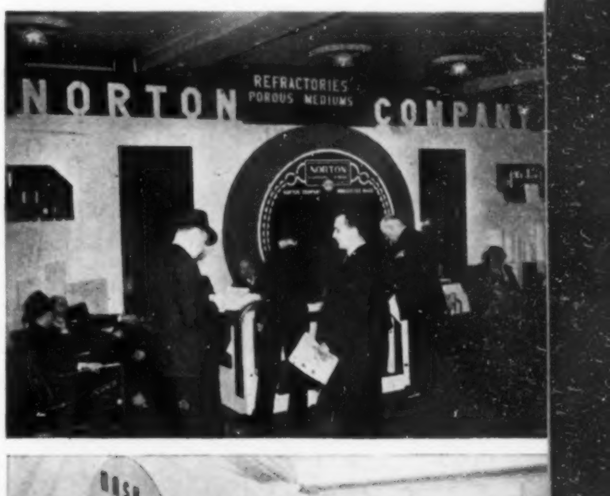
Allis-Chalmers Mfg. Co. exhibited an improvement in its low-head, heavy-duty sifters which is now standard in this class of equipment. Made in sizes from 10 to 60 sq. ft. of cloth, the improved sifters now permit easy removal of the sieves from the side, by the loosening of four bolts and a tension rod.

Two new developments were shown by Richmond Mfg. Co. One of these is a production-type laboratory sifter, said to give sifting results directly comparable with those of large-sized machines. The area of each screen is exactly 1 sq.ft. The system may be arranged for conducting either continuous flow or time-limit laboratory sifting tests.

Several installations have already been made of the Johnson electrostatic separator which was in development at the time of the last Chemical Exposition. This machine, produced by Ritter Products Corp., is available for large-scale applications in tonnages as high as 25 to 300 tons per hour. It is now being applied in such fields as the treatment of phosphate rock flotation concentrates. The new process is based on the discovery that it is possible to reverse the polarity of the electrostatic charge on many common economic minerals, thereby facilitating separation. To meet various requirements the company is now prepared to supply seven types of electrostatic separators, with three different types of electrical equipment.

The most recent development among the equipment manufactured by Sutton, Steele & Steele, Inc., and shown by Separations Engineering Co., is called the "Air-Float Stoner." Designed for the removal of stones, glass, bits of metal and other foreign materials from grains, soybeans and similar farm products, the new stoner makes the separation on the basis of the difference between the density of the stock and its contaminations. Material flows downhill across a rapidly oscillating deck, being rendered fluid by a diffused air-stream from a blower passing up through the deck. Stones sink immediately, work uphill and pass out of a throat at the higher end. The clean stock leaves the lower end of the deck.

A new application for its mixing machinery was shown by Turbo Mixer Corp. in the form of a new style sub-aeration flotation machine. The machine employs the company's standard gas-absorber unit which is said to be suitable for use in flotation cells from 1 to 10 ft. in diameter, without the use of an auxiliary air supply for aeration. Larger sized units can be produced if necessary by supplying air under pressure to the gas absorber unit.



CHEM & MET

PLANT NOTEBOOK

Timesaving Ideas for Engineers

NEW CHART SOLVES HEAT TRANSFER CALCULATIONS FOR FLUIDS IN VISCOUS FLOW REGION

D. O. HUBBARD and J. V. ROTH

Respectively, Hooker Electrochemical Co., Buffalo, and Case School of Applied Science, Cleveland

A METHOD of correlating heat transfer data in the viscous flow region, which is of special significance in the petroleum industry where transfer in this region is commonly experienced, is presented here. When fluid flows through a pipe in viscous flow, its viscosity at the heat transfer surface varies widely from the average viscosity. Sieder and Tate (*Ind. Eng. Chem.*, **28**, 1936, p. 1429) introduced a corrective factor which takes into account the viscosity gradient by means of the ratio μ_a/μ_w, that is, the ratio of average viscosity of the main fluid stream to its viscosity at the temperature of the tube wall.

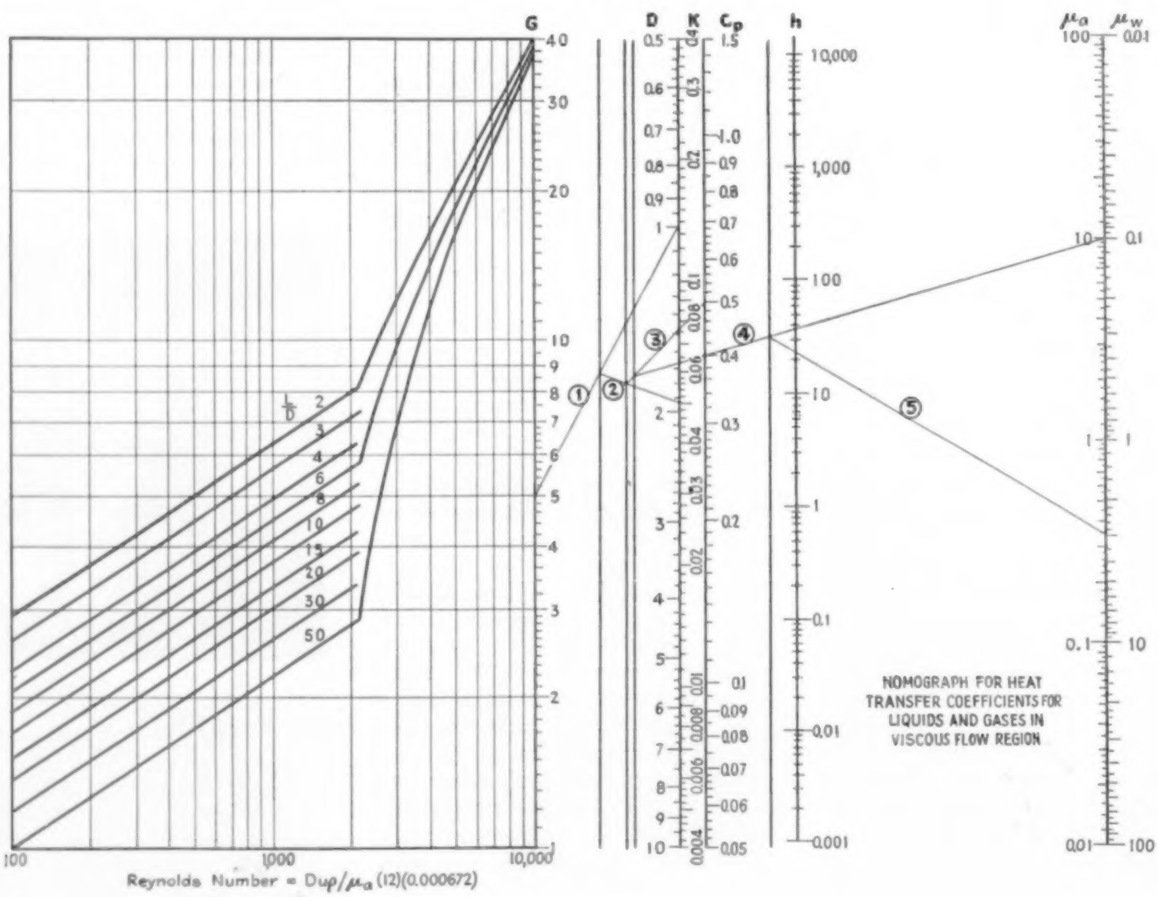
The mathematical relationship is:

$$G_a = \frac{h\,D}{12\,K}\left(\frac{2.42\,C_p\,\mu_a}{K}\right)^{-1/3}\left(\frac{\mu_a}{\mu_w}\right)^{-0.14}$$

The accompanying nomograph graphically expresses the function G as a function of the Reynolds number, $Re = Du\rho/\mu_a(12)(0.000672)$. In the relationship above, h = coefficient of heat transfer in B.t.u. per hour, sq. ft. and deg. F.; D = inside pipe diameter in inches; K = thermal conductivity in B.t.u. per hour, ft. and deg. F.; C_p = specific heat in B.t.u. per lb. and deg. F.; μ_a = average viscosity in centipoises; μ_w = viscosity at tube wall in centipoises; u = fluid velocity in ft. per sec.; ρ = fluid density in lb. per cu. ft.; and L = heated length of the tube in ft.

As an example of the use of the chart, a liquid is passed through a heat transfer tube having an inside diameter of 1 in. and a heated length of 4 ft. The flow velocity is 1.77 ft. per sec., the liquid density is 50 lb. per cu. ft., and the viscosity at the main stream temperature is 10 centipoises. If the thermal conductivity is 0.05 B.t.u. per hour, ft. and deg. F.; the specific heat is 0.5 B.t.u. per lb. and deg. F.; and the viscosity at the wall temperature is 3 centipoises, what is the liquid film heat transfer coefficient?

Solution: Solving for the Reynolds number, we get (1)(1.77)(50)/(10)(12)(0.000672) = 1,100. At this value, pass upward on the graph to L/D = 4, then horizontally to the G scale. Construct Line 1 connecting G with D = 1. Construct Line 2 connecting the first reference line with K = 0.05. Construct Line 3 connecting the second reference line with C_p = 0.5. Construct Line 4 connecting the third reference line with μ_a = 10. Construct Line 5 connecting the fourth reference line with μ_w = 3. Read the answer, h = 23 B.t.u. per hour, sq. ft. and deg. F., from the intersection with the h scale.



CHEM & MET REPORT ON

War-Time Protection of Industrial Plants

TO CHEMICAL EXECUTIVES, ENGINEERS
AND ALL PLANT PERSONNEL

The vital importance of chemicals in the industrial set-up of the nation has been clearly demonstrated: without an adequate supply of chemicals a plane remains unbuilt, a tank lies unused, an army does not advance. And just as important as these chemicals are the industrial plants and trained men that make them possible. Now that America is at war, these plants so precious to the national economy must be protected from the double dangers of enemy attacks from without and traitorous stabs from within. Sabotage, incendiary bombs and incendiarism, enemy air raids: these three, but the greatest of these is sabotage. And of the many forms of sabotage, fire is the most prevalent, the most dangerous, and the most insidious. The plant that immunizes itself against damage from fire, whether intentional or accidental, can survive unscathed the next few years of danger and destruction.

War-Time Protection of Industrial Plants

SUMMARY AND CONCLUSIONS

Sabotage by fire is the most dangerous of all war-time enemies of American chemical and process industries. Fortunately, protection against such damage can be had by strict adherence to orthodox methods of fire prevention, although it will be necessary to double and triple normal peace-time measures. Common sense and stern precautionary steps are the best protections against all types of sabotage and espionage of industrial chemical and process plants.

Enemy air raids may consist of efforts to cripple or destroy certain industrial plants by the use of incendiary bombs. Magnesium incendiaries are relatively harmless if properly understood and fought. A fine spray of water can quickly extinguish them and prevent damage in most cases. However, it is first necessary to have proper equipment in sufficient quantities, properly trained personnel and many sources of water in order to fight such bombs successfully.

Reasonable protection of equipment and personnel from distant effects of high explosive bombs can usually be obtained from light weight shutters and other simple methods. Blackouts can best be accomplished by the use of proper screens or baffles, although most plants require individual study before protective steps are taken.

Protection Against Sabotage

As one means of preventing industrial sabotage, the F.B.I. has been engaged in a plant survey program undertaken to suggest means for protecting the facilities of basic industries whose products are vital to war and the national security. Some 2,400 plants are on this priority list and 1,700 have been surveyed. In addition, 12,000 industrial plants may subsequently be covered by the program. Upon request, surveys of chemical plants having government contracts will be made by the Army, Navy or F.B.I. but no surveys will be made by the Office of Civilian Defense. However, the responsibility of self-protection is largely up to the individual plant.

METHODS OF SABOTAGE

Common forms of sabotage against the chemical and process industries include: (1) damage to machines or equipment by breakage, corrosive chemicals, abrasives or explosives; (2) damage to power stations, water supply, gas mains, or other key points; (3) arson, which includes intentional negligence and the creation of specific fire and explosion hazards; (4) theft or damage to blueprints, formulas, or other confidential matter; (5) damage or destruction to railroad connections, vessels at docks, and other means of transportation; (6) damage to raw materials or finished products and interruptions or upsetting of operating conditions. The last named is the most vulnerable in the chemical and process industries.

Sabotage Bombs—Bombs used by the saboteur are usually either dependent upon physical manipulation or are set to explode at a predetermined time. Under the first classification come impact, tilting, and trigger bombs, the first two types being rarely used. Trigger bombs, if discovered on time and properly handled, may never detonate, and may furnish valuable clues to the identity of the saboteur. The trigger mechanism may be anything from a string stretched across a path or attached to a door to a device which will close an electrical circuit or set off a trigger-hammer mechanism when the package is opened.

Time bombs are the favorite of the saboteur. These may be timed by fuses, clockwork mechanisms, or chemicals, and are particularly dangerous for there is no means of determining when they may explode. Fuses are widely used even though they do not always burn their entire length. If an ordinary alarm clock is used, the elapsed time usually must be less than 12 hours. Chemical bombs depend on the length of time a corrosive acid takes to eat its way through a container to come in contact with an explosive mixture. By varying materials and thicknesses of the containers, ignition can be set days or weeks in advance.

SABOTAGE BY FIRE

Sabotage by fire, the most common and dangerous of all methods, usually involves interference with the fire protection of the property prior to starting the fire. This interference may consist of tampering with fire-fighting equipment by plugging the nozzles, emptying the contents, cutting the discharge hose of extinguishers, or replacing the fluid with flammable liquids. Standpipe and sprinkler systems can be made inoperative by closing valves, removing valve wheels and damaging hose and connections. Burring a thread on hose outlets will make their use impossible unless suitable adapters or universal couplings are carried in stock.

Incendiary Materials—Most sabotage fires are started by use of incendiary devices or chemicals subject to spontaneous ignition. For example, sodium may be placed under openings in the roof or at the bottom of a water spout so that rain would result in ignition of the sodium and adjacent material. Or it may be wrapped in heavy paper and tossed into water near piers. Eventually the water will work through the paper covering and if the floating sodium is in contact with oil-coated piles under a pier, ignition of the pier may result.

An ingenious device for starting fires made its appearance in the last war and consisted of a short piece of lead tubing in the center of which was placed a thin copper disk folded to the tubing around the periphery. In one end was placed picric acid and in the other end sulphuric acid. Both ends of the tube were plugged with wax and capped with lead. The sulphuric acid would eat through one copper disk and upon reaching the picric acid, fire would occur. The most recent adaptation of this device is the "incendiary pencil", which has the appearance of an ordinary pencil and is fitted with lead and eraser. These pencils may be deposited in combustible materials in trains, ships, or stored in plants.

Gases are sometimes used for starting fires although there is danger of premature explosion. The usual plan

is to leave an open flame in the room where gas is permitted to escape. When the gas arrives at the fire there is a flash back to the source, which may start a fire in combustible materials at that point.

Celluloid scrap is employed chiefly to accelerate a fire. Ordinary tallow candles are a very common device for starting delayed-action fires, since they burn at the rate of approximately 1.3 in. per hour. Streamers are also commonly employed with candles. The use of volatile and flammable liquids has become more common recently. Rifle fire from outside the premises may start fires in highly flammable chemicals.

Overloading electrical circuits has also been used by saboteurs to cause fire. Since cut-off fuses afford protection against dangerous overloading, the use of "jumpers" or pennies in the cut-off box in place of the fuse may sometimes be linked with sabotage.

PREVENTING FIRE

Eternal vigilance is the best insurance against fires. These can be kept to a minimum by insistence upon removal of all rubbish, careful and constant check-up of personnel and material arriving at the plant, and by daily inspection of standpipes, fire equipment, sprinklers and auxiliary appliances (extinguishers should be so located and sealed that removal or tampering would be quickly detectable). Hose couplings should be examined frequently to insure protection against injured threads.

The first thing the saboteur is likely to do is to close the sprinkler valves. Therefore, although frequent inspection is a good practice, sealing coupled with inspection or automatic electric supervision is still better.

Thorough study should be made of the various sources of auxiliary water and methods of using these in case of damage to the main supply. Unless the water main system is cross-connected and valved, so that any broken section might be segregated, serious bleeding of water may result from pipe rupture.

Storages of highly flammable materials, such as gasoline, oil or certain chemicals should receive special protection because of the serious fire risk and the ease with which saboteurs can exploit this risk. This may involve construction of dikes around tanks, placement of tanks underground or removal to a less dangerous location.

PREVENTING SABOTAGE

Other than the elimination of fire hazards, the following steps are the most important for prevention of industrial sabotage: (1) selection and identification of operating personnel; (2) restrictions and check-ups on visitors; (3) trained guards; (4) protective fencing and lighting; (5) care of confidential documents.

Personnel Identification—Some executives feel that if each employee punches an appropriate time card upon entering and leaving the plant, unauthorized persons are not likely to enter the premises. This is not true. Each employee should be provided with a photo-identification card, preferably of safety paper to prevent alterations, bearing his signature, employment number, and specific plant assignment. This card should be enclosed in a sealed plastic container and prominently displayed on the person at all times. Badges with different colors and shapes to designate plant assignments make it especially difficult for a stranger to move about a chemical plant unnoticed.

Section 2 of the Act of June 28, 1940 provides in part "no aliens employed by a contractor in the performance of secret, confidential or restricted government contracts shall be permitted to have access to the plans or specifications, or the work under such contracts or to participate in the contract trials, unless the written consent of the head of the government department concerned has first been obtained, and any persons who willfully violate or through negligence permit the violation of the provisions of this subsection shall be fined not more than $10,000 or imprisoned not more than five years or both." Chemical manufacturers having government contracts should pay particular attention to the above statute as all violations are their direct responsibility. Manufacturers might do well to remember that persons of German descent have attained a particularly thorough penetration into the chemical industries of this country. While most of these persons are undoubtedly loyal Americans, it is inevitable that some few may be willing to carry on subversive activities.

Guards and Police—The police chief of a chemical plant should be charged with safeguarding the plant and its material from all subversive activities. He should control traffic and maintain a clear route for fire-fighting equipment. The handling of explosive missiles, whether high explosive or incendiary bombs, should be one of his responsibilities and his men should be given special training for this work.

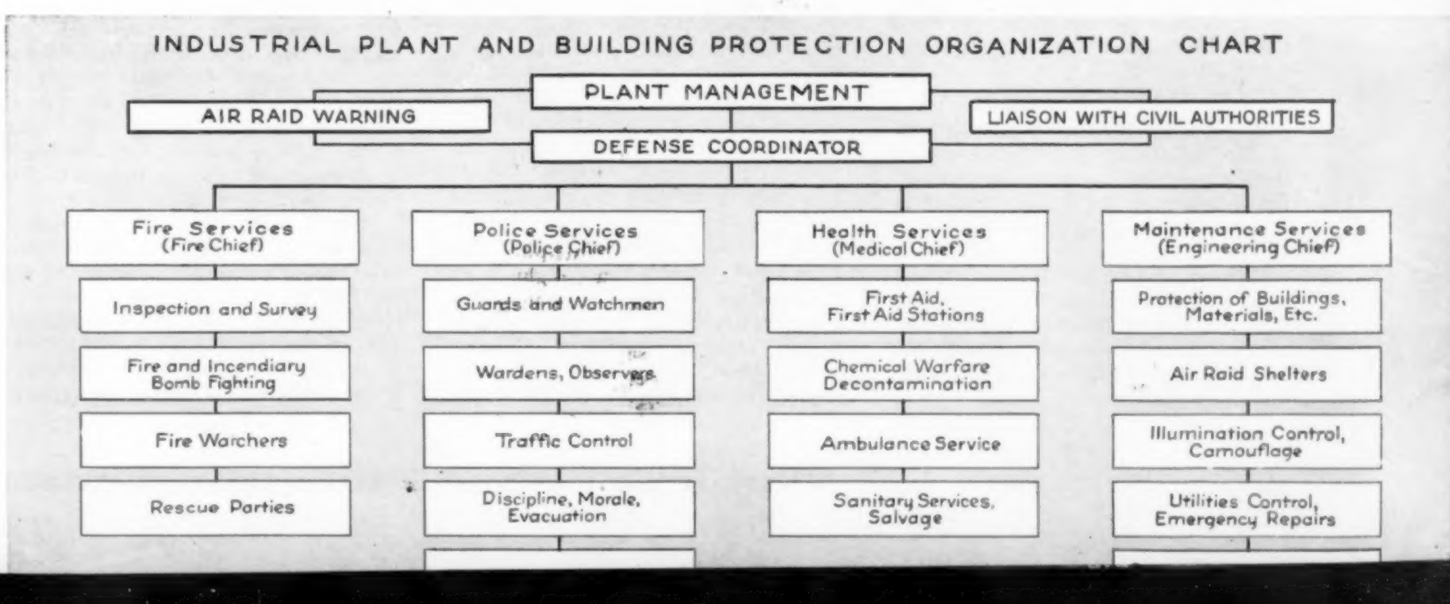
The beat of guards should be changed at irregular intervals. Guards' shifts should not coincide with those of regular employees. All guards should be well trained in the efficient use of the firearms they carry.

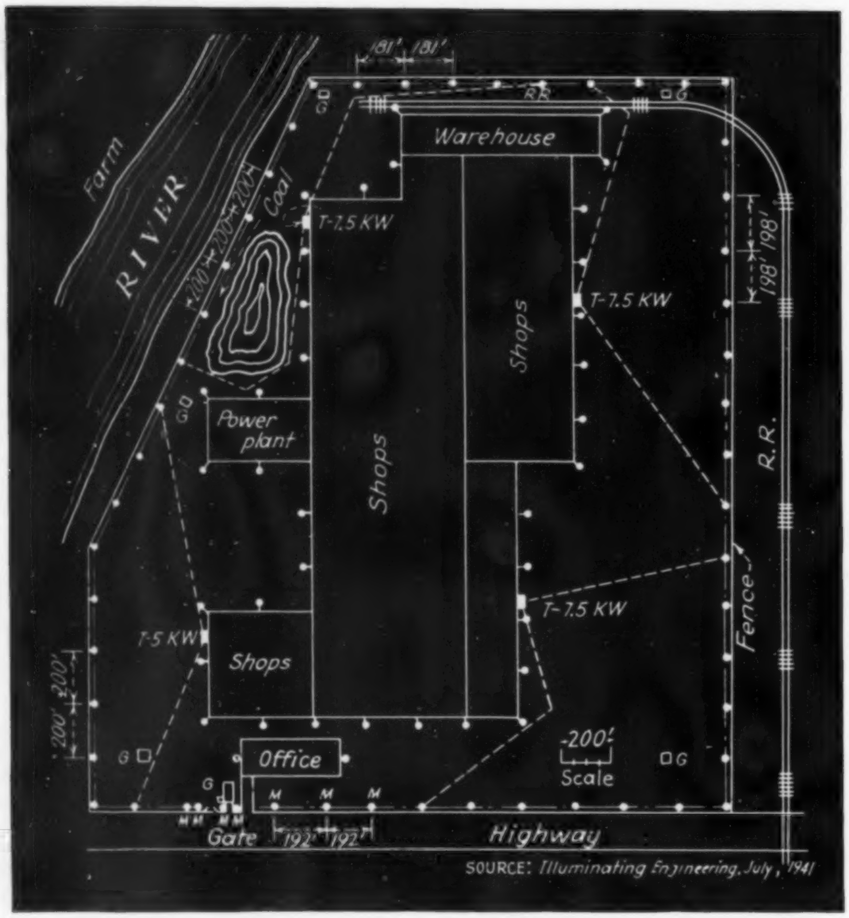
A spot check-up of lunch boxes should be made at frequent intervals and uninspected packages should never be allowed into the plant. A guard should be on watch as trains enter the plant premises, both at the point of entrance and also where box-cars are opened or sealed. An adequate set-up for safe handling of mail and protection of mail-sorting personnel should be adopted. It would be a good idea for plants to change the locks on all gates, be certain that only authorized persons have keys and to alternate locks at intervals.

Adequate repair facilities should be available and placed in locked sheds at strategic locations. Necessary tools should be so arranged as to be readily moved from place to place. Open drains and sewage lines, especially those having intermittent flow, should be barricaded with a grill if the diameter is more than about 2 ft.

PROTECTIVE FENCING

Fencing should be at some distance from the area to be protected, known in military terms as the "throwing distance." The purpose of the fence is to provide a barrier against a *determined* intruder, and it should be erected so as to aid in the conservation of man power if guarding becomes necessary. In cases





Plan of a typical industrial plant showing fence, gate and yard lighting. G indicates the guard shack, T-7.5k.w. a constant-current transformer, and M shows the lamps on multiple supply. The fence lighting units are mounted 25 ft. above ground and 10,000-lumen, 20-amp. series lamps are used for an illumination of 0.19 footcandle

where it is not possible to locate a fence around a plant area, screens must be provided over windows or other openings in buildings.

Protective Lighting—In making arrangements for protective lighting, a few basic facts should be remembered: (1) lighting or guards alone will not afford protection; (2) indicating devices that register the presence of someone in the plant property where he should not be are not effective; (3) the guard, if possible, should be stationed in a shack and have a telephone and a marine-type concentrating searchlight of 1,000 watts; (4) the guard should not move from place to place; (5) there should be no glare from any direction.

FENCE LIGHTING

Proper fence lighting of 0.15-0.2 footcandles enables the guard to see anyone loitering outside the fence or attempting to get over it. A 25-ft. mounting height is the most practical for reducing the glare.

Horizontal light distribution will depend to a large extent on local conditions. It is good practice to use asymmetrical distribution, concentrating the major part of the light along the fence, especially near corners.

However, in addition to a safely wide spread of light at the gate, there should be down light at 30 deg. from the vertical, aimed at the center of the roadway to make identification quick and positive. Lights near the entrance should be on a separate multiple circuit for additional reliability and many plants are providing a diesel-engine generator set for emergency use.

Inside lights should never be turned on and off by the watchman as he makes his rounds. A low, uniform illumination of 0.25 footcandle is sufficient. For low bays, 200-watt lamps on 70-ft. centers and mounted 12 ft. from the floor are good practice. Shipping platforms are unusually vulnerable since men on trucks or cars are often not plant employees and large quantities of finished products are congregated here. One typical shipping platform has 200-watt lamps mounted vertically on the side walls 12 ft. above the platform and spaced on 35-ft. centers. Illumination is about two footcandles. Shipping platform lights should burn all night.

Signalling Systems—Signalling systems constitute an important line of defense against sabotage. Unfortunately, these services are easily disrupted. It is suggested, therefore, that chemical plants undertake surveys of their normal and emergency signalling systems in order to ascertain whether those services need guarding or supplementing. Spare parts for the most vulnerable pieces of equipment should be on hand. A survey in each plant will determine the means for coordinating facilities with those of the municipality.

Underground lines, which are normally more protected than those overhead, can be sabotaged by dropping acid, bombs or other destructive agencies into manholes. These acts are less likely to be observed than would those against overhead lines. Hence all manhole covers should be locked and cables should be covered with acid-resistant shields, where feasible. Only authorized persons should ever be allowed to open a manhole, work in it or be near it when it is open.

In Case of Sabotage—Any plant owner, superintendent or foreman should immediately report to the nearest office of the F.B.I. details of any information indicating the possible violation of sabotage or espionage laws. No attempt at evaluation or investigation of the information should be made. Suspicious circumstances should never be discussed. Particular attention must be paid to collecting and preserving all possible clues, and detailed reports should be written on the spot as these may later prove invaluable in ascertaining and convicting the saboteur and any accomplices in the plant.

HANDLING SABOTAGE BOMBS

There is no safe way for handling an unexploded bomb. It was deliberately designed that way. Experience, however, has shown that the damage from such bombs can be limited by barricades, blasting mats, sand bags and trenches.

First thing to do on discovering a suspected bomb is to decide whether or not to move it. This is determined by the amount of damage the bomb is likely to do. The amount of unburned fuse can often be ascertained at a glance, and a guess of the time available based on the fact that standard safety fuse burns at a rate of one foot in 30-40 seconds. If the fuse is pulled out, speed and promptness are essential. The fuse should be thrown in a safe direction instantly to avoid injury from explosion of the detonator. In an open bomb, if the wiring and detonator are exposed, the least dangerous thing to do is to cut the two wires leading to the electric blasting cap as near to the cap as possible. If the bomb is of disguised type, no immediate attempt should be made to open it.

Deflecting the Blast—If the bomb is to be left in its original location, measures should be taken instantly to deflect the blast. Some of these are: (1) clear the danger area of all occupants; (2) see that the bomb is not disturbed or any nearby objects moved that might be connected with a trigger mechanism;

(3) establish an organized guard around the danger area; (4) open all doors and windows to allow any blast to disperse; (5) surround the bomb with sandbags or felt mattresses (without metal springs) to direct the blast in the direction where it will do least harm; (6) remove all flammable materials from the area and shut off gas, electric, steam and compressed air lines; (7) salvage valuable machinery or equipment.

If the bomb is to be moved, the following suggestions may be helpful: (1) avoid turning it on its side or upside down; (2) a heavy felt mattress will afford a certain amount of protection if kept between the operator and the bomb; (3) occasionally a bomb can be moved by dragging it with a rope at least 50 ft. long; (4) gloves worn by the operator will aid in preserving fingerprints.

Never Put Bombs in Water—If a bomb contains an electrical mechanism, water may cause a short circuit and result in detonation. Or it may contain a metal that bursts into flame in contact with water, or an acid that is affected by water. Even a fuse and dynamite bomb will not be affected by water if a water-proof fuse and blasting gelatine are used. If it is essential to use some quenching agent, light lubricating oil or coal oil are the best. The oil tends to stop the clockwork mechanism. Gasoline is also recommended as readily available and efficient in deadening the dynamite.

Dangers in Opening—It is extremely hazardous for unskilled persons to attempt to open or even handle unexploded bombs. Only the expert will remember that the obvious or intended way is usually the wrong way. A suspicious package wrapped in paper and tied with a string should be opened by leaving the string intact and cutting a hole through the paper. If it is a box with a lid, all catches and the lid should be left untouched, and an opening made in the end or the bottom of the package.

Gathering Evidence—Extreme care should be taken before and after an explosion to gather all evidence that may aid in identification of the saboteur. The following steps should be taken: (1) care should be exercised not to add or destroy fingerprints; (2) the bomb should be photographed in its original location from various angles; (3) the package should be examined by X-ray, using a fluoroscope, to show up objects such as clock-work and trigger mechanisms; (4) extensive notes should be taken on the spot; (5) witnesses should be questioned as to the sound of explosion, amount and color of flash, smoke and violence of the concussion as evidenced by ringing of the ears (this will indicate if it was a low explosive such as illuminating gas or blasting powder, or high explosive such as dynamite, nitro-glycerine, guncotton, or TNT; (6) all fragments of wire, clockwork, burned fuse, pipes, etc., should be carefully preserved.

Table I—Emergency Incendiary Fighting Equipment[1]

Four 3-gal. buckets.
1 hand pump, stirrup type, with 30 ft. of ½-in. hose and dual jet-spray nozzle.
1 extension ladder.
1 long-handled shovel.
1 long-handled scoop and hoe.
1 hand ax.
1 pair heavy gloves.
1 large flashlight or oil lantern.
1 fire-fighting mask.
1 soda-acid fire extinguisher.

[1]Civil Air Defense, by A. M. Prentiss, McGraw-Hill Book Co., New York (1941).

Protection Against Incendiarism

Every chemical and process plant should arrange with neighboring plants and communities for mutual aid in an emergency by listing special hazardous processes, fire fighting equipment and arranging for hose adapters if different types of threads are used. A well-ordered mutual aid plan also includes a roster of skilled workers such as engineers, mechanics, welders and electricians. One example of such cooperation is given by the Allis-Chalmers Mfg. Co. in Wisconsin. This plant calls the entire personnel of the municipal fire department for a personally conducted tour throughout the plant once a year. Firemen likely to be called to that plant know what to do immediately.

PRECAUTIONS AGAINST FIRE

However, there must also be independent organization and training of private brigades in chemical plants, for the municipal and neighboring fire departments will no doubt be too busy to help in the event of fires from incendiary bombs.

Over 20 fires that occurred during the first six months of 1941 which resulted in damages of $200,000-$5,000,000 were due to the following: (1) excessive concentration of combustibles and damageable stocks; (2) fighting of fire by employees instead of summoning the fire department; (3) watchman's delay in calling the fire department; (4) improper valve supervision; (5) removal of protective features such as fire walls and sprinklers; (6) lack of protection from special hazards; (7) inadequate water supply; (8) laxity of management in providing rigid fire protection.

Members of the fire brigade should realize that in case of fire, the sprinkler control valves must be examined to see that they are opened wide. Records over 50 years show that sprinkler performance throughout the country has had an overall efficiency of 96 percent. The failures were primarily due to lack of maintenance or closed valves. Drills should include the making of hose connections, unreeling and stretching hose without kinks, and coupling and uncoupling.

The best precaution against the spreading of fires is a sufficient number of shut-offs for all gas lines, additional switches for electrical lines, and by-passes and valves for water pipes. A sufficient amount of pipe and fittings and electrical appliances should be on hand for the prompt repair of all lines.

Cotton and rubber-lined hose should have water run through them at least four times per year and pressure tests should be applied at least once per year. Linen hose should be kept clean and dry. Plants having electrically driven fire pumps with power obtained from outside may find it desirable to purchase an auxiliary gasoline or diesel engine pump.

Normal concrete construction is more resistant to fires than the unprotected steel work often found in chemical plants. In some cases it might be wise to cover exposed steel or wood in highly vulnerable areas with a metal lath and cement plaster coat. In England, it is reported that for every ton of structural steel irreparably damaged by explosive bombs, 10 tons are destroyed by fire.

Woodwork can be protected to some extent by the use of certain inorganic salts and fire retardant paints. Tanks storing flammable chemicals should be mounded to avoid spreading burning liquids over large areas and adequate fire walls should be provided so as to localize fires within buildings. Packing materials, gaskets and other rubber stocks, small quantities of paint, rope and wrapping materials when stored in orderly fashion are not considered a serious menace. Oakum, lamp black, some welding compounds and cleaning fluids can be sources of fire and must be treated accordingly. Paint storage in bulk creates a special problem as the use of wooden barrels for shipping results in leakage of linseed oil.

Table II—Penetration of Magnesium Incendiary Bombs[1]

Weight of Bomb, lbs.	Inches of Penetration[2] Reinforced Concrete	Sand	Earth	Mild Steel Plate
2.2	3.5–4	6	6	0.25
4.3	5–6	42	60	0.38
12.0	.....	57	84	....
22.0	.....	72	108	1.0

[1]Chemical Warfare School, Edgewood Arsenal.

[2]Approximate. Represents minimum thickness of material required to resist penetration.

Table III—Floor Protective Materials Against Burning Magnesium Incendiary Bombs[1]

Material	Minimum Layer For Protection, in.
Brick dust	1.5
Slate dust	1.3
Foamed slag (ground)	2.0
Pumice (ground)	1.3
Household ash	2.3
Boilerhouse ash	1.8
Kaolin	1.5
Limestone (ground)	1.3
Asbestos wallboard	0.8
Ash or ballast concrete	1.0
Gypsum comp. (certain types)	0.8

[1] 2-lb. size. From "Incendiary Bombs and Fire Precautions", British Government.

A heavy bomber can carry from 1,000-2,000 of 2.2 lb. magnesium incendiary bombs. In large towns, out of every 12 bombs dropped, 10 would probably fall in open spaces and burn without serious damage. Of the remaining two, one would probably glance off a sloping roof or fail to function so that no more than one out of a dozen would start a serious fire. Thus 75-80 fires might be started along a distance of about 3 miles, or an average of one fire every 60-70 yd.

MAGNESIUM INCENDIARY BOMBS

Ignition of magnesium incendiary bombs occurs on impact. The starting mixture ignites the thermit of which the aluminum burns violently, robbing the iron oxide of its oxygen. This furnishes intense heat for 40-50 seconds and produces molten iron, the pressure of which causes spattering of the iron and of burning pieces of magnesium. The burning thermit ignites the magnesium body, which continues to burn quietly for 10, 15 or even 20 minutes. The burning of the magnesium itself is easily detected as there is less spattering and an intensely white flame is produced. These bombs often carry a high explosive in order to discourage extinguishment. However, after two minutes of burning there is little danger from such explosives.

Protection—Floors of attics should be covered with non-flammable material such as a 2-2½ in. layer of dry sand or earth or by a sheet of 20-gage corrugated iron insulated from the floor by a thin layer of sand or earth. Chicken wire stretched about 1–2 feet above the floor helps in breaking the impact of the bomb and in dispersing it. Rafters and joints in the attic or top floor should be coated with fire-resistant paint or heavy whitewash.

Every small building and every 8,000 sq. ft. area of large buildings should be provided with the following emergency supplies: four 3-gal. buckets, two for sand and two for water; one hand pump with 30 ft. of ½ in. hose and a dual jet-spray nozzle; one extension ladder; one long-handled shovel; one long-handled scoop and hoe for removing bombs; one hand ax; one pair of heavy gloves; one large flashlight or oil lantern; one fire-fighting mask; one soda-acid chemical fire extinguisher.

The British have found that a 2-lb. incendiary bomb can penetrate 4 in. of reinforced concrete or ¼ in. of mild steel plate and it therefore may penetrate a plank-on-timber roof, depending on the slope of the roof and the angle of impact. A bomb will often burn through a ⅞ in. board flooring.

Extinguishment—It is dangerous to approach a magnesium bomb for about a minute after ignition because of the spattering effect; molten metal may be thrown as far as 50 ft. during this phase. A solid stream of water should never be directed on the bomb while the thermit is burning, since it produces an explosive effect on striking the molten mass, thus spreading the fire. Water spray on burning thermit has little effect since thermit supplies its own oxygen and cannot be smothered, while the high temperature of the combustion makes cooling impossible. A *stream* of water should not be directed on the bomb when the magnesium itself is burning. A solid stream of water striking this hot metal (3300 deg. F.) scatters the material with explosive force due to the formation of steam and to the rapid chemical reaction of water and magnesium to liberate hydrogen.

However, a water *spray* on burning magnesium is very effective because of the following actions: (1) in contact with the burning metal, the water spray is converted to steam, thereby producing a cooling effect; (2) the blanket of steam above the fire helps dilute the 21 percent oxygen in the air to a point below 16 percent necessary for combustion; (3) burning of the bomb is accelerated and thus may be reduced 10 minutes or more; (4) the floor and surrounding combustible materials are wetted and cooled.

SPRAYING EQUIPMENT

For spraying magnesium bombs with water, the British use a stirrup hand pump equipped with 30 ft. of hose and a ⅛ in. nozzle giving a jet carrying 30 ft. or a spray carrying 15 ft. Two or three people may be required; one handling the nozzle, one pumping and one replenishing the water. The man with the nozzle approaches the bomb and first extinguishes any fire which may have been started, by playing a *stream* of water directly upon the secondary fire. As soon as this fire has been put out a *spray* is used on the bomb itself. It is generally necessary to use 6-7 gal. of water for each bomb. However, the stream from a large fire hose is sufficiently strong to be played directly on the bomb, and if there is sufficient volume of water, it may be consumed completely in a few seconds.

The knapsack type extinguisher with a 5-gal. portable tank curved to fit the back is fitted with a hand-operated piston pump. This is a one-man extinguisher and has proved effective, although it has the disadvantage of sometimes having to be refilled with water while in use. A soda-acid extinguisher is about as effective in extinguishing magnesium fires as plain water in equivalent amounts.

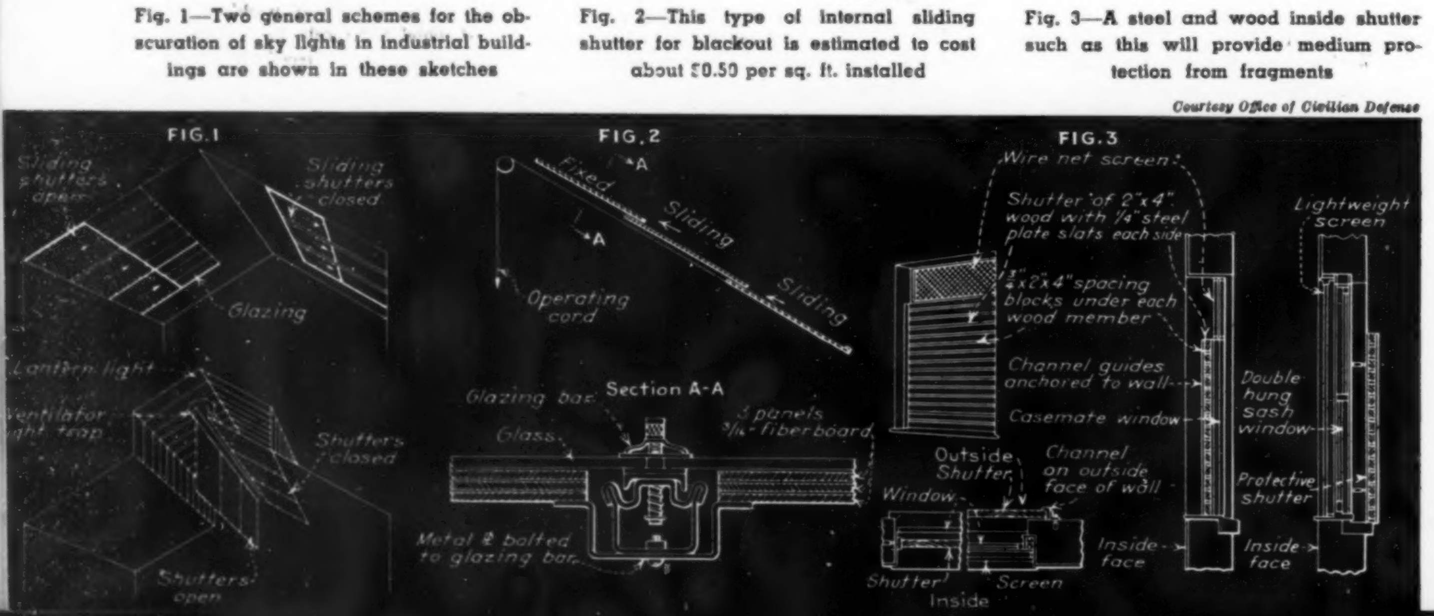
Commercial fire resistant powders, talc, or fine sand, provided they are dry, can be used to cover burning magnesium bombs. However, such materials should be used only when the bomb is burning on a solid floor with little combustible material nearby. If possible, the fighter should be protected with a mask or gas-tight goggles and heavy gloves. Half a bucket of sand is placed on the floor near the bomb, and

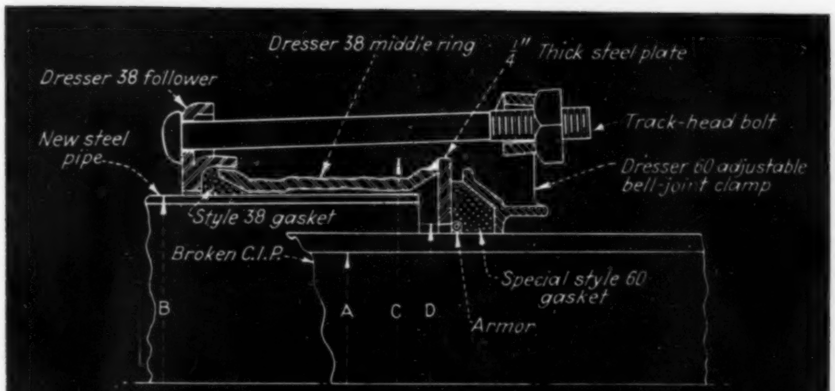
Fig. 1—Two general schemes for the obscuration of sky lights in industrial buildings are shown in these sketches

Fig. 2—This type of internal sliding shutter for blackout is estimated to cost about $0.50 per sq. ft. installed

Fig. 3—A steel and wood inside shutter such as this will provide medium protection from fragments

Courtesy Office of Civilian Defense





Specifications

C.I.P. SIZE "A" DIA.	STEEL PIPE O.D. "B"	MIDDLE RING	FOLOWER THICKNESS	STYLE 38 GSKT. SEC.	BOLTS	STL. PLATE DIA. C	STL. PLATE DIA. D
3	5 9/16	1/4 x 5	1/4	1/2 x 1	4-5/8 x 9	6 3/4	4.085
4	6 5/8	1/4 x 5	1/4	1/2 x 1	4-5/8 x 9	7 3/4	5.185
6	8 5/8	1/4 x 5	1/4	1/2 x 1	6-5/8 x 9 1/2	9 3/4	7.285
8	10 3/4	1/4 x 5	1/4	1/2 x 1	6-5/8 x 9 1/2	12	9.485
10	12 3/4	1/4 x 5	1/4	1/2 x 1	8-5/8 x 9 1/2	14	11.585
12	16	1/4 x 7	1/4	1/2 x 1 1/8	8-5/8 x 12	17 1/4	13.685
14	18	1/4 x 7	1/4	1/2 x 1 1/8	9-5/8 x 12	19 1/4	15.835

The modified Dresser couplings and sleeves, known as air-defense fitting No. 1, makes it unnecessary to square the ends of severed 3-14 in. cast-iron mains or to remove any of the pipe no matter how far back cracks might extend. In demonstration, repairs were completed in 15 min. by the use of this fitting. Other emergency measures for closing main breaks are discussed in *Gas Age*, Nov. 20, 1941

the operator places sand around and on top of the bomb with a long-handled shovel. It is then possible to shovel it into the bucket on top of the remaining sand, and then cover with sand. The bucket is then removed by use of the shovel handle or a long stick.

The sand method should be used only after all thermit has burned out. Sand and other abrasive materials should be kept away from moving machinery. Granulated pitch, experimentally, offers promise of being an excellent extinguisher. A snuffer will stop flying particles of molten metal and will confine the heat so that the operator can approach, but the bomb will continue to burn vigorously beneath the snuffer and may cause serious damage unless soon removed.

Protection Against Air Raids

Every chemical plant must be prepared to take care of itself without asking for municipal help although collective action by groups of neighboring companies is advisable in industrial centers. As the Office of Civilian Defense does not recommend immediate building of large bomb-proof shelters, since what raids are expected will probably be sporadic, plants should give particular attention to protection of personnel. Employees taking defense courses at industrial plants after working hours should not expect to be paid for such activities if these are connected in any manner with the problem of personal safety.

In large factories, it is a good idea to assign employees in a particular section a definite color scheme and then to have markings in the plant so that if each employee follows his own color markings, he will arrive at his designated shelter. This scheme eliminates verbal instructions and prevents men from going to the wrong shelter or losing their way. The knowledge that safe shelters have been provided increases morale before and during air raids.

Shelters — Steel or concrete frame buildings are relatively safe from anything but a direct hit from a high explosive bomb. Most modern office and factory buildings of more than four stories and of reinforced concrete or steel frame construction offer suitable locations for shelters within the building. The room selected for a refuge should have its ceiling strengthened to support any debris which may fall upon it. English and German specifications require strengthening to carry a load from 200-400 lb. per sq. ft. in masonry buildings. In frame buildings, this could probably be somewhat less. Lateral protection can be obtained by closing windows and doors with concrete, brick or sandbags. No gas or steam conduits should enter or pass through the room.

If multi-story buildings are to be used as shelters, the following features should be avoided: large proportion of voids to solids in external walls; one-cell floors with no partitions between external walls; timber floors or floors of weak construction; buildings of doubtful lateral strength; skylights or glass roofs; heavy objects such as storage tanks or machinery on top floors; high chimneys at or above the roof level.

PROTECTION FROM AERIAL BOMBS

Protection from fragments of bombs which fall not closer than 50 ft. is given by 30 in. of earth or sandbags, 13 in. of brick, or 1.5 in. of steel plate. Glass embedded with wire mesh is only slightly more resistant to blast than plain glass, but the splintering effect is considerably less. Laminated glass also reduces splintering but may be blown out completely.

Shutters—A reasonable amount of protection from 75 percent of the fragments from heavy bombs can be provided by shutters of ¼ in. mild steel. Wood shutters ¾ in. thick will provide fair protection from glass at distances from 50-200 ft. where windows are partly shielded by adjacent walls. To withstand blasting effects, shutters should be held firmly, preferably in steel channels anchored with bolts. For very large windows, a strong frame may be placed on the outside to break the openings into several smaller openings to each of which a shutter should be attached.

There is no sure way to prevent the breakage of glass from distant effects, such as air blast and earth vibrations. However, of the several treatments for the protection of glass, those which have proved most resistant include burlap-bituminous treatment, wire mesh and screens, wired glass, and controllable shutters. For further construction details, "Glass and Glass Substitutes" should be consulted.

Protection of windows from near effects of high explosives requires the consideration of both the blast itself as well as fragments. For this reason, extensive measures for such protection are necessary and the complete removal of windows and the use of substitutes such as blocking with brickwork, gravel-filled planking, and sandbags may be necessary. For most plants, the risk of near effects should be accepted, as only protection against distant effects is practicable.

REPAIRING MAINS

Broken, bombed or impaired gas mains can be valved or plugged off by the use of conical-shaped plugs suspended on a steel cable across the bomb crater. The plug can be lowered to the end of the broken main and a cup-shaped piece of steel welded to the plug end of the cone enables one man to push the plug inside the main. Gas mains

can also be plugged with an air-inflated bag. With the use of this method, it is necessary that standpipes occur at frequent intervals in order to enable the operator to fit the bag into the main quickly. Greasing off will plug up to 12-in. low-pressure mains. This method has the disadvantage of leaving the pipe with a large amount of heavy grease inside with no means of removing it other than digging up the main.

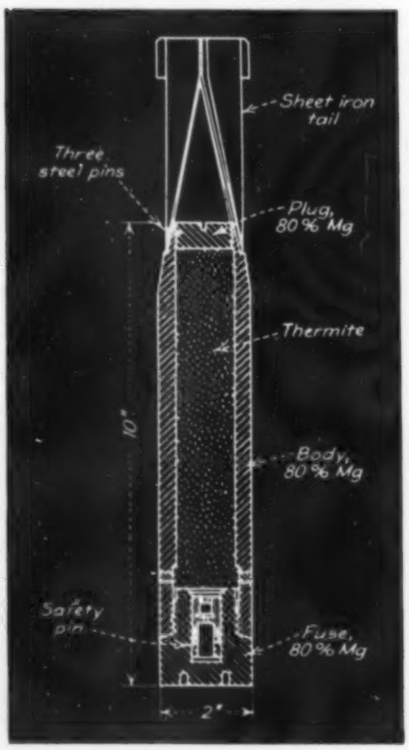
A new coupling and sleeve, designed by Dresser, enables emergency repairs on a broken main without sawing off the jagged ends. This improved design, known as Air Defense Fitting No. 1, is shown in an accompanying drawing. In demonstration, repairs were made in 15 min. by use of this fitting.

BLACKOUT OF CHEMICAL PLANTS

To stage a "blackout" without proper equipment and trained personnel only creates dangerous confusion. Except for immediate contingencies, little or nothing can be done to increase the effectiveness of a blackout while a raid is in progress. "Blackout" (see references) has been published by the Office of Civilian Defense to suggest how certain typical installations may be effectively blacked out. This information is the most authoritative available but is intended to be modified and adapted to each specific plant.

In most types of construction, opaque shutters can be built over all windows, light-locks provided at entrances and provision made for thorough ventilation and prevention of condensation. Outside lights should be covered with blue shades, and white guide lines should be painted where necessary.

Magnesium incendiary bombs such as this are extensively used by the Germans. They can best be extinguished by applying a fine spray of water



Simplest way of blacking out is to spray on paint internally or externally. Paint selected for this purpose should be waterproof and sufficiently opaque in one coat only. As the cost of removing ordinary paint may be three or more times the cost of applying it, any paint used should be removable by a convenient and inexpensive process. External application of paint by sprayers is usually cheapest and best, as it prevents glare from the glass and, if properly selected, will assist in camouflage.

A suitable paint can be made up of 100 lbs. of black ground in oil, 50 lbs. of paste dryer, 2 gal. of turpentine, ½ gal. boiled linseed oil, and 1 pint of terebene, giving 10 gals. of blackout paint.

A suitable stripper would consist of 5 gal. of benzene, 3.3 gal. of acetone and 15 lbs. paraffin wax to give 10 gal. of paint remover. Glass can be painted with blackout plack paint at about $12.00 per 100 lb. can having a covering capacity of 400-500 sq.yd.

Aluminum painted storage tanks, water towers, tank cars, marble or other light stone structures, tin roofs or light concrete walls, and other light reflecting surfaces should be painted or otherwise treated to produce a dark rough mat surface.

Sugar refineries, oil fields and refineries, brick and pottery works and power and utility plants may produce some glow, depending on the type of process and efficiency of operations. The iron and steel industry furnishes the best example. In full operation, these mills and their slag dumps are sometimes visible from the air at a distance of 25 miles or more. Another major problem is concealing the glow from beehive or byproduct coke ovens in operation. To erect covered obscuring sheds over this type of plant would be difficult nor would it be easy to extinguish these ovens quickly. The lengths of such batteries and the amount of glow therefrom make them easy to recognize from the air.

Glare from blast furnaces can be screened by use of large fireproof louvered hoods carried over the charging platforms and kiln chimneys can be dealt with by the use of asbestos sheet baffles. In oil fields, lights and gas flares can be quickly eliminated. However, heavy gases released without flaring in still damp weather do not rise rapidly and constitute a definite fire hazard. In this event, operators should close in the well or extend the flare line by a riser. For large gas volumes disposed of through a single line, such risers might have to be 40-50 ft. high. However, there is no general method of preventing glow suitable for universal application and each plant must be examined and dealt with individually to prevent costly mistakes.

Table IV—Protection Against Bomb Fragments[1]

Material	Required Thickness, Inches [2]
Mild steel plate	1.5
Brick wall	13.5
Plain concrete	15.0
Reinforced concrete [3]	12.0
Specially reinforced concrete [4]	10.0
Sand or earth revetment	30.0
Gravel or stone between wood sheathing or corrugated iron	24.0

[1] From "Protective Construction". Structure Series Bull. 1. Office of Civilian Defense.
[2] For protection against fragments of a 500-lb. bomb at a distance of 50 ft.
[3] Normal structural reinforcement.
[4] Reinforced to resist high local stresses in diagonal tension.

Warning — Plant men considering blackout preparations or other air raid precautions should not contact the Office of Civilian Defense in Washington, but should first consult with their city, county or state Defense Council. Plants having Army and Navy contracts and considered vulnerable to an attack have already received instructions. Under any circumstances, however, it is advisable to become thoroughly familiar with the information already available (see bibliography) before making elaborate preparations for blackout or protection from high explosive bombs. Mistakes are easy to make and can be expensive, time consuming and wasteful of vital materials.

Bibliography

The Office of Civilian Defense has issued a variety of pamphlets and instructions, among which the following may prove of most interest to the chemical and process industries. All responsible plant men are urged to obtain copies of these publications.

A Handbook for Air Raid Wardens. 10 cents.
Protective Construction. Structures Series, Bulletin No. 1. 25 cents.
Suggestions for State and Local Fire Defense. Fire Series Bulletin No. 1. 10 cents.
Protection of Industrial Plants and Public Buildings.
OCD News Letter. Official Bulletin of the Office of Civilian Defense issued approximately fortnightly.
Emergency Medical Service for Civilian Defense. Medical Division Bulletin No. 1.
Air Raid Warning System.
Blackouts. 25 cents.
Civilian Protection; How to Organize it in your Community.
Glass and Glass Substitutes. Protective Construction Series 1. 10 cents.
A Civilian Defense Volunteer Office; What it is, How it is Set Up, What it Does, How to Organize it.
Memorandum on Municipal Signaling Systems. 10 cents.
Instructor's Outline. First Aid Course for Civilian Defense. Issued by American National Red Cross in cooperation with Medical Division, OCD.
Advanced First Aid for Civilian Defense.

Where no price is indicated, orders may be placed with Office of Civilian Defense, Washington, D. C. Where price is indicated, purchase should be made from Superintendent of Documents, Government Printing Office, Washington, D. C., with advance remittance.

Reprints of this 8-page report are available at 25 cents per copy. Address the Editorial Department, *Chem. & Met.*, 330 W. 42nd St., New York, N. Y.

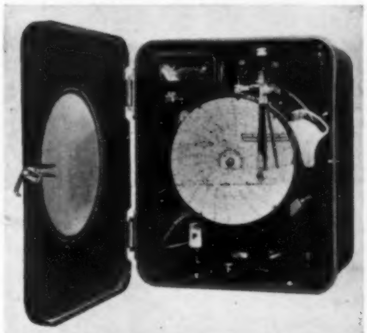
Machinery, Materials and Products

CHEM & MET PROCESS EQUIPMENT NEWS

Ring Balance Meters

EMPLOYING the ring balance principle in the construction of flowmeter manometers, the Ring Balance Instrument Co., 740 North Franklin St., Chicago, Ill., has introduced a line of indicating, recording and integrating mechanical flowmeters which are readily adjusted to meet a range of capacities without dismantling the instrument. These instruments are built in two basic types, one for low-differential, low-pressure applications, and the other for high-differential, high-pressure applications. Differential pressure from the primary element (orifice or venturi tube) is conducted through flexible, self-compensating tubes to the two sides of a ring balanced in a vertical plane on a knife edge bearing. A sealing liquid in the lower half of the ring is displaced proportional to the differential existing in the two chambers above the liquid formed by a partition at the top of the ring. Attached to the lower side of the ring is a range weight (which is easily changed to change the range of the instrument), this weight producing a torque when the ring moves under the influence of an unbalanced differential pressure to achieve a definite equilibrium position for each differential. Motion of the ring balance is transmitted to the recorder pen through a cam mechanism which compensates for the square root relationship. A simple integrator mechanism is available, operating on the ratchet principle, which drives the integrating counter through an index wheel having 1,800 teeth and so operated that a movement of one tooth corresponds to but one-sixth of 1 percent of the total flow reading.

Ring balance flowmeter



Noise Shields

FOR PROTECTING workers against fatigue, irritability and nervous exhaustion, resulting from excessive industrial noise, Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa., has introduced a new type of ear plugs known as MSA Ear Defenders which are said to reduce loud noises to about one-tenth their former loudness, yet to permit hearing of warning signals and conversation. These plugs, introduced after long research by recognized authorities in the field of acoustics and industrial health, consist of a tapered tube molded from surgical type soft rubber, consisting of two barriers, an outer one of metal and an inner one of soft rubber, separated by an air space. Design permits easy insertion and removal without danger to the ear drum. Each pair is packed in a plastic pocket container in which the Ear Defenders may be kept when not in use.

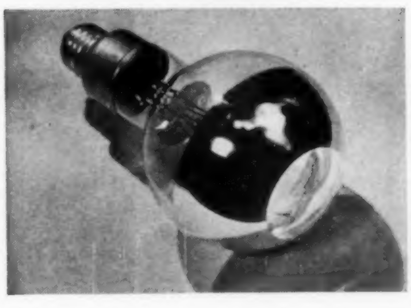
Noise-reducing ear plugs

Bellows Pump Seal

SEVERAL new features are incorporated in a new bellows type pump seal developed by the Crane Packing Co., 1800 Cuyler Ave., Chicago, Ill. As shown in the accompanying illustration, the seal consists of but two parts, a bellows with flanged ends formed from a special synthetic rubber compound, and a spring bearing against the inside shoulders of the flanged ends to hold the contact facings against the sealing washer on the one end and the driving base on the other. Serrated contact facings formed in a series of concentric grooves and flat-faced ribs are said to produce effective sealing action. The seal can be installed readily in difficult positions, according to the manufacturer, since it cannot be installed incorrectly. It is said to be suitable for use in contact with a wide variety of liquids including greases, oils, alcohols, etc.

Bellows pump seal

Bullseye infra-red lamp



Oven Collecting Main

A NEW DEVELOPMENT, described as a basic improvement in byproduct coke oven design, has been announced by the Otto Construction Corp., 500 Fifth Ave., New York, N. Y. This is a compensating collecting main system which balances pressure and controls the temperature of the gas at the top of the charge. The system conveys the gas from freshly charged ovens, when the gas is rich and abundant and comes off at a rate which builds up pressure, across the tops of ovens that are in the final stages of distillation. Thus it decreases the temperature and equalizes the pressure and so keeps the entire gas take-off properly balanced. Control of gas flow in the main and in the oven above the coal charge is said thus to be improved. Regulation is automatic, requiring no adjustment at the riser pipes during operation. This system is said to increase the yield of tar up to 10 per cent, to give up to 15 per cent better yield of benzol, and to increase the production of the toluol fraction up to 20 per cent.

Infra-Red Lamp

FOR USE in heating and drying operations employing infra-red radiation, the Birdseye Research Laboratories of Wabash Appliance Corp., Brook-

lyn, N. Y., has announced a new type of radiant heat lamp, said to make possible 100 percent control of heating efficiency. The new design puts to practical use for heating what is termed the "spilled heat" lost in ordinary combinations of heating lamps and commercial reflectors. The company points out that although many efficient heating reflectors provide convergent, parallel or divergent heat beams as needed, there is still an average of 25 percent of the heat rays that are spilled outside the control of the reflector. The new lamp, known as the Bullseye type, employs a ring lining of pure silver to prevent this loss. The ring is sealed inside the bulb at a location just below the focal point of the filament, reflecting the formerly spilled heat rays into the control area of the reflector which projects them down to the heating area. The new lamp is of 250-watt size, with tungsten filament, designed to fit a standard Edison screw socket.

Drum Opener

OPERATING on the same principle as a can opener, a new semi-automatic drum opener announced by the Turner & Seymour Mfg. Co., Torrington, Conn., is said to be easy and speedy in use and to eliminate the injuries associated with the usual hammer and cold chisel method of opening drums. Known as the Westco Drum Opener, the new machine cuts a smooth-edged opening in straight-chime metal drums up to 35 in. in height. The corrugated cast iron base can be bolted to the floor. Four steel uprights support the cutting unit which is counterbalanced for easy adjustment to the height of the drum. After adjustment the cutting unit is locked in position. By closing the cutting unit lever, the drum is perforated, after which turning the crank cuts the head out.

Special Conveyors

TWO NEW TYPES of conveyors designed especially for use in defense industries have been announced by Standard Conveyor Co., North St. Paul, Minn. One is a wood roller conveyor designed for handling explosives in ammunition and armament plants. Both rollers and frames are made of maple, with metal parts of brass or bronze to prevent sparking. Bearings are either of the ball type or of oiless bronze. The second new conveyor is a portable belt piler equipped with rubber-tired wheels for piling, loading and unloading boxcars. The machine is readily removed from one site to another by simply hooking the lower end to a motor truck. A crank on one side is provided for raising and lowering the carrier which in a typical model has a recommended piling height of 8 ft. although it will pile to 10 ft., with 4 ft. as the minimum piling height. The conveyor is equipped with rough-top belting to prevent commodities from slipping when the conveyor is set for high elevation piling.

Emergency Power Unit

TO MEET THE NEED for emergency light and power protection, created by national defense activities, the Electric Storage Battery Co., 19th St. and Allegheny Ave., Philadelphia, Pa., has announced four new Exide emergency light and power units for industrial use. The units are said to be similar in principle to a large number which have been manufactured by an affiliated company in England for use in emergency lighting in bomb areas and air-raid shelters. These units are available in capacities from 3,400 to 10,000 watts, while other systems made by the company are built in sizes ranging from 240 to 100,000 watts. A unit is used in connection with an Exide battery of either the chloride or the flat plate type. An automatic transfer switch instantly transfers the battery to the emergency lighting circuit upon failure of the normal a.c. supply. As soon as a.c. service is restored, the emergency lighting circuit is instantly transferred back to the a.c. supply. Immediately upon resumption of normal power, the battery automatically is placed on high charge rate. As soon as recharging is completed, the high rate is automatically cut off and a copper oxide rectifier then supplies a trickle charge just sufficient to maintain the battery fully charged.

Can-opener-type drum opener

Wooden conveyor for explosives plants

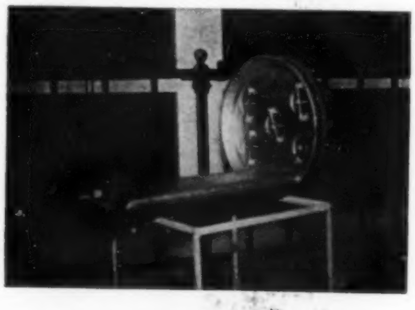
Piston-Type Bubble Tray

TO FACILITATE making up distillation columns for pilot plants, development laboratories and also small plant-scale fractionation operations, Southwestern Engineering Co., 90 West St., New York, N. Y., has developed a piston-type bubble tray which can be installed in standard pipe to make up a column of any desired height in diameters ranging from 4 to 24 in. A woven asbestos packing is used to seal the periphery of the tray against the pipe wall. The number of bubble caps used varies with the size of the tray, ranging from one for the 4-in. size, to 18 for the 24-in. size. A down-flow pipe to carry liquid to the next lower tray is formed integrally with each tray. Trays and caps are made of close-grained gray cast iron although castings of other compositions can be supplied if necessary. Standard tray spacing is 18 in. but down-flow pipes of different lengths may be supplied.

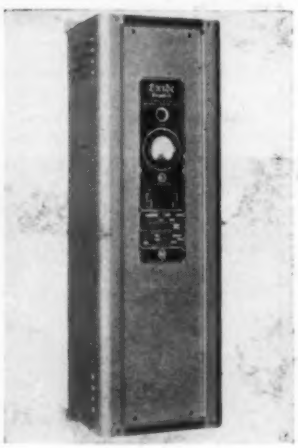
Inspection Door

DESIGNED especially to withstand high temperatures, a new furnace inspection door has recently been developed by Gillette Kiln Sales Co., 712 Investment Bldg., Pittsburgh, Pa. This

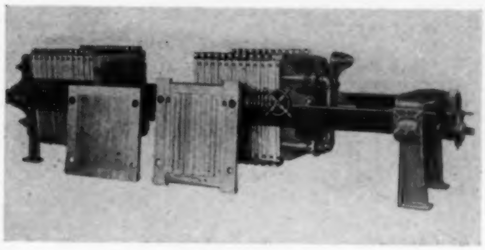
12-in. bubble tray with five caps



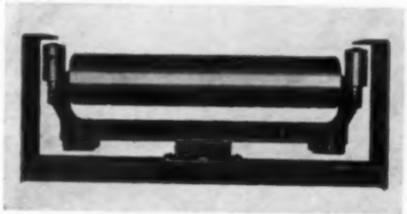
Emergency light and power unit



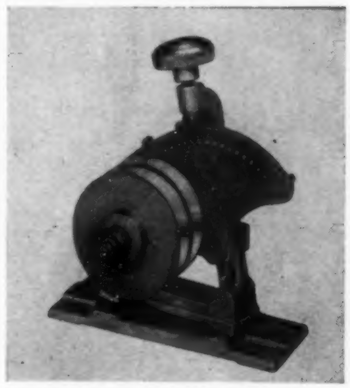
New furnace inspection door



New filter-type thickener



Self-aligning idler



JFS-Cub variable-speed transmission

new door is suitable for attachment to industrial furnaces and kilns having continuous temperatures up to 2,500 deg. F. The door consists of a cast iron slide which rides vertically in a cast iron frame assembly. When closed, the slide with its heat-dissipating fins, closes the porthole. To open, the slide is raised to bring a framed rectangular piece of Pyrex heat-resistant glass opposite the porthole. Still further raising permits inserting an instrument or tool into the furnace. The door is claimed to be easily installed on new or existing furnaces. Either blue or clear heat-resisting glass may be had.

Variable Speed Transmission

A SMALL variable speed transmission for use with V-belt drives has been announced under the name of JFS Cub by Standard Transmission Equipment Co., 416 West 8th St., Los Angeles, Calif. The unit, which is capable of a speed range of 3.3-1, is small and light in weight but capable of transmitting as much power as may be handled by an A-section V-belt (½x11/32 in.) The unit comprises a pair of variable V-pulleys, the pulley spindle being capable of movement toward or away from the motor or driven machine, thereby automatically changing the driving ratio of the variable pulleys. Any speed in the range of the machine may be selected by moving a lever along a sector and locking it in place by turning a knob.

Self-Aligning Idler

AUTOMATIC CORRECTION of misalignment of either the carrying or return run of a non-reversing conveyor belt supported on flat-roll idlers is possible with a new positive, swiveling, self-aligning idler developed by Link-Belt Co., Indianapolis, Ind. The new idler has a centrally pivoted cross member which, besides being equipped with the flat idler roll for supporting the belt, has a vertically mounted actuating roll at each end for lightly contacting the edge of the belt when its lateral misalignment exceeds a predetermined amount. But slight pressure of the belt edge against the actuating roll serves to swivel the idler unit on the pivot sufficiently to guide the belt automatically back to proper aligament. When used on return runs, one idler is placed close to the tail shaft so that the belt is guided centrally on the pulley, and another at every 10 or 15 idler spaces. On the carrying run, one idler is placed just beyond the loading chute and one every 10 or 15 spaces thereafter.

Dual Pump Drive

To ASSURE uninterrupted water supply from deepwell turbine pumps, the Peerless Pump Co., 301 West Avenue 26, Los Angeles, Calif., has announced a dual drive which is normally powered by an electric motor head, but can instantly be switched to a source of stand-by power, such as a gas, gasoline or diesel engine, or a steam turbine. The stand-by power is connected to the unit by means of a right-angle gear, and may be brought into operation either manually or by automatic control. This company also provides dual drive pumps with steam turbines as the primary power and an internal combustion engine connected with the secondary right-angle gear.

Filter Type Thickener

WHAT IS SAID to be a totally new principle in devices for the thickening of suspended solids is the new filter-press-type thickener recently developed by T. Shriver & Co., 810 Hamilton St., Harrison, N. J. The new thickener does not depend upon settlement, but rather upon removal of a part of the liquid by filtration through a permeable filter membrane, while the solid suspension is flowing through a channel of greater or lesser length. The method is said to be particularly suitable for solids which are slow in settling, either because their density approaches that of the liquid in which they are suspended, or because they are in a finely divided state. Another advantage claimed for the new method is its extreme compactness, making it suitable for use on rapidly settleable material where the cost of special materials of construction would be too high if ordinary thickeners were used.

This machine is a modification of the company's standard plate-and-frame filter press. Many of the parts are interchangeable with those of a filter press of the same size. The frames are so designed that filter cake does not build up on the filter medium. Instead, all solids are continuously swept out of the unit in a stream of slurry which is progressively thickened. Thus a continuous stream of relatively thin slurry enters the thickener and continuous streams of clear liquid and thickened slurry are discharged. There is no need to stop the unit at any time for cleaning or removal of cake.

Employing a standard filter press skeleton, the new unit uses special types of plates and frames. Each frame contains a spiral groove which starts in one corner and spirals to the center where it passes through the frame and spirals outward on the other side of the frame to a different corner. A spiral on one side of a frame has the reverse rotation of that on the opposite side. Thickener plates contain spiral ribs which match the ribs between the grooves of the frame. A slightly different construction used for wood frames has vertical wood baffles on both sides with vertical channels feeding from one side of the frame to the other. Wood plates are grooved similarly to ordinary wood filter plates.

In operation the slurry to be thickened is pumped into the unit, reaching the channels of the frame first. From the channels a portion of the liquid passes through the filter medium, issuing as clear liquid which drains away on the plates and thence from the unit. All suspended solids in the original feed remain in the slurry stream in the frames and are continuously discharged from the unit. Slurry velocity through the frames prevents building up any cake. In

batch thickening, the thickened slurry returns to the supply tank and is circulated until the desired thickness is obtained. In batch washing, material is recirculated to the desired thickness and then fresh water is added to the supply tank at a rate equal to the effluent discharge until the material is adequately washed. The unit is also adaptable to continuous or intermittent countercurrent washing and leaching. Multiple thickeners, tanks and pumps are employed for such operations. In a number of such applications already made, remarkable decreases in processing time compared with thickening by settlement are claimed by the manufacturer.

Improved Controller

MODEL 30 is the type number given to the latest design of Stabilog controller introduced by the Foxboro Co., Foxboro, Mass. Changes in the new instrument consist principally in refinements, since it has not been found necessary to alter fundamental principles of operation. The new Model 30 employs the company's recently designed universal rectangular case which, when panel mounted, extends only $\frac{3}{4}$ in. from the panel surface. All operating adjustments can be made from the front of the case, the adjusting mechanisms for change of control point, throttling range and reset resistance being immediately accessible when the door is opened. The operating mechanism, however, is protected and concealed behind a removable plate. Unit construction simplifies any necessary replacement of the measuring system, or change in the type of control. The controller incorporates three principal functions: the first is proportional pneumatic control, which is adjusted to the smallest value that will result in stabilization following a disturbance of process conditions. The second is the reset function, acting simultaneously with the first, to establish stabilization at the desired point of control. The third function provides a temporary additional correction which is large if the rate of change of the process variable is fast, or negligible if it is small.

Equipment Briefs

A NEW photo-electric colorimeter, known as the AC Electrophotometer, has recently been announced by Fisher Scientific Co., Pittsburgh, Pa. This model, which operates on alternating current, incorporates a compensating means capable of handling all ordinary fluctuations in line voltage. The unit is compact, completely self-contained and designed for simplified operation. It employs four different illumination intensities and can use three different types of absorption cell to cover a wide range of solution volumes.

FOR APPLICATIONS on industrial equipment, where the blind mounting of nuts is necessary, Elastic Stop Nut Corp., 2332 Vauxhall Road, Union, N. J., has announced a special anchor type vibration-proof nut which may be permanently riveted to the inside of the structure. Each nut incorporates this company's self-locking feature, consisting of a fiber locking collar which is an integral part of the nut and prevents the bolt from becoming loose after it has been installed in the nut, regardless of the severity of vibration to which it is subjected.

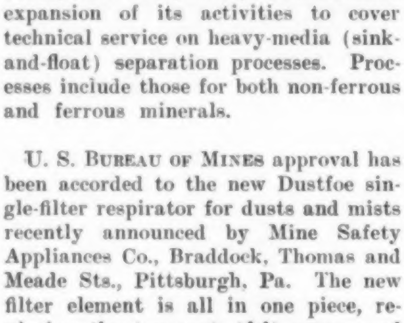
DOWNINGTOWN IRON WORKS, Downingtown, Pa., has recently set up a separate division for the design and manufacture of heat transfer equipment. The new heat transfer division, which is being housed in its own building, will design and build steel and alloy heat exchangers for various process heat transfer applications, including heaters, coolers, condensers, hot water heaters, brine coolers and refrigeration exchangers.

IN A RECENT ANNOUNCEMENT, American Cyanamid Co., 30 Rockefeller Plaza, New York, N. Y., has announced expansion of its activities to cover technical service on heavy-media (sink-and-float) separation processes. Processes include those for both non-ferrous and ferrous minerals.

U. S. BUREAU OF MINES approval has been accorded to the new Dustfoe single-filter respirator for dusts and mists recently announced by Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa. The new filter element is all in one piece, replacing the two-part (felt screen and cellulose) filters used previously. The filter is more porous on the outer side so that larger dust particles are filtered out first, thus preventing rapid build-up of breathing resistance through clogging of the filter. The unit is light in weight and compact, offering low breathing resistance and full vision in every direction. A protective filter cover helps to prevent contamination of the filter by grease and dirt.

A NEW LINE of drum controllers for small cranes and hoists, having several new features, has been announced by Cutler-Hammer, Inc., 315 North 12th St., Milwaukee, Wis. A rope-operating lever, employing a new equalized-torque principle, eliminates the sheave wheel, rope guard and external return spring, providing smooth, easy operation when the rope is pulled at an angle. A new anti-plugging feature increases the drum life by making it impossible to whip the drum from the full forward to full reverse position. The drum can be reversed quickly, but yet a definite time delay is required in the off position.

New conveyor oven



ADDITION of a series of paint and lacquer spray hoses in inside diameters from $\frac{1}{4}$ to $\frac{1}{2}$ in. has now given the B. F. Goodrich Co., Akron, Ohio, a complete line of synthetic rubber-lined hose from $\frac{1}{4}$ in. to 10 in. inside diameter. The company's product, Ameripol, is the synthetic rubber used. The new paint-spray hose uses a black oil-resisting compound, designed for 150-lb. working pressure in all sizes.

NATIONAL-ERIE CORP., Erie, Pa., has announced new large-capacity continuous extruding machines for the insulation of wire and cable with thermoplastic compounds. The new units are available with plasticizing cylinders from $3\frac{1}{2}$ to 12 in. in diameter, the cylinders being completely jacketed for high temperature operation. Improved axial extruding heads suitable for tubes or straight extruding of miscellaneous commercial shapes are standard equipment. A variety of head constructions are available for insulating service.

Conveyor Oven

DESIGNED for heating, drying and heat-treating in the temperature range up to 1,250 deg. F., a new conveyor-type convection heated furnace has been announced by The Gehnrich Corp., Long Island City, N. Y. When desired, preheating and cooling sections can readily be added to the heat processing chamber. The furnace is constructed of alloy steel, eliminating the need for refractory lining. The walls are of patented insulated panels, packed with mineral wool blankets. Through metal joints are eliminated, thus reducing heat losses and providing for ready expansion and contraction of the walls and for easy assembly, enlargement or relocation. Heat is provided by electric heating elements and transferred to the ware by means of air moved by a large-capacity fan located above the oven which draws air from the heaters and discharges it over the full length and width of the oven. The hot air then recirculates to the heater. An external gas- or oil-fired heater can also be used if desired. The conveyor consists of a wire-mesh belt running over steel drums at both ends of the oven and driven by a motorized variable-speed drive.

MORE THAN 2 YEARS ON THE JOB — NO TROUBLE

"'1000' valves have regulated perfectly since they were installed over two years ago. We have never opened them up."
—Case No. 177

Three Years Remarkable Service

"The first Streamlined Valves we bought from you have been in about three years — we have had no trouble whatsoever. This service is remarkable."
—Case No. 179

4 YEARS ON THE LINE

"Our first '1000' valve has never been out of the line in four years. We adjust it constantly for different pressures and it stays put."
—Case No. 135

4 YEARS SERVICE AND STILL GOING

"We have dozens of these Streamline Regulators in use, yet over a four-year period we have not spent one dime for repair parts."
—Case No. 143

After 18 months . . . seat and ring show no wear . . .

"As far as maintenance is concerned, we put them in and forget about them — they really control the pressure."
—Case No. 309

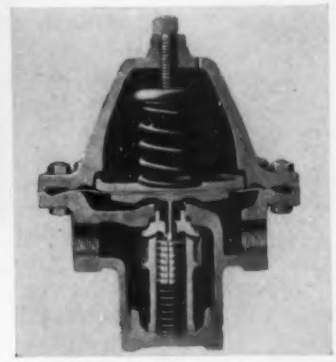
5 YEARS WITHOUT SERVICE ATTENTION

"We had to have capacity and close regulation—we got all that and more — this valve has given excellent service—no repairs needed in five years."
—Case No. 325

A CASH STANDARD "GET ACQUAINTED" COLUMN

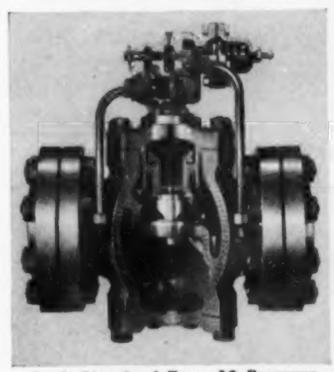
Question: **"Don't you people make anything besides that Streamlined Valve you talk about so much?"**

Answer: **"Yes Sir; we do! And we propose to picture one or two of them here each time."**



Cash Standard Class D Pressure Reducing Valve; inexpensive; dependable. Used in regulating steam, hot water, cold water, air, oils, many chemicals and most gases. Sizes 1/4" to 2"; screwed ends.

Initial pressures up to 250 lbs., reduced pressures up to 200 lbs. Bodies in iron, bronze or steel. Trim; iron, bronze, stainless steel, monel metal, or nitralloy.

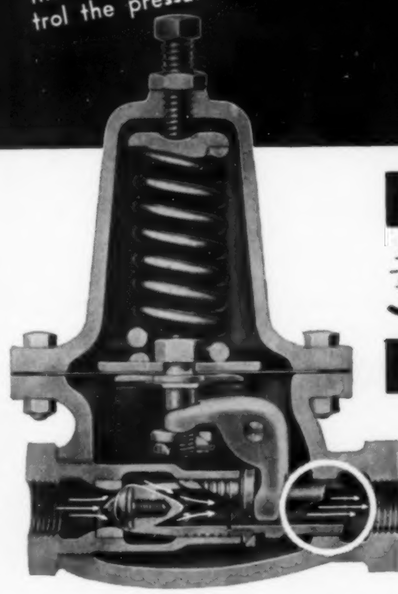


Cash Standard Type 10 Pressure Regulating Valve—self-contained, pilot operated. For holding reduced pressure within extremely close limits.

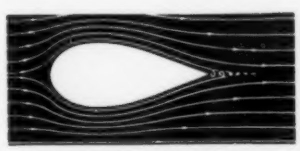
Sizes: 2" to 12". Initial pressures up to 600 lbs.; highest reduced pressure 250 lbs. For water, air, Freon, ammonia, any non-corrosive gas or oil. Valve operating fluid not wasted: it discharges to outlet pipe.

Bodies: iron, bronze, steel. Trims: iron, bronze, stainless steel, or monel metal. Ends: screwed, flanged, or ammonia type.

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVE



• The Aspirator (circled in "1000" illustration above) gets the inner valve wide open to meet the demand and hold delivery pressure constant.



GIVES THIS FLOW PATTERN

The Streamlined form of the inner valve eliminates turbulence. It produces the flow pattern shown above which makes for maximum capacity when it is needed most, and permits accurate pressure control under toughest working conditions.

★ Accurate, reliable pressure reduction service for steam, air, oil—most anything that flows — at definite cost savings. That is what you can expect from a CASH STANDARD Streamlined Reducing Valve. In addition you have the following points that you can definitely figure on — smooth operation — elimination of failures and spoilage — speedier production — and an end to worry and bother. Years of service in a wide variety of installations show that users of the "1000" valve do get all of these benefits. Sizes 1/4" to 2" screwed ends.

• Straight path for the fluid through the flow tube—gives you better pressure control and greater capacity.

• Streamlined flow around the inner valve—eliminates turbulence—thereby gives you best control under varying loads.

• Send for Bulletin 1000—it gives you the complete story.

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A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS.. VALVES

Plate Glass Manufacture

THE CREIGHTON (Pa.) plant of the Pittsburgh Plate Glass Co. has the distinction of being first in several respects. It is the No. 1 works of the company, and one of the first plants to manufacture by continuous process. The first glass was produced in this plant in 1883, and it has been in almost continuous production since that time. For many years it has been producing 7/64 in. polished plate for use in the manufacture of laminated safety glass.

Raw materials for the production of glass consist of sand, soda ash, salt cake, limestone and cullet. The batch is weighted, mixed and elevated and conveyed to hoppers. From here the material is fed into the melting end of the furnace which has a capacity of 1,400 tons of glass. Molten glass leaves the refining end between rolls. The glass ribbon is annealed in a gas-fired lehr 400 ft. in length. While the glass is cooling the edges are trimmed, inspected and cross cut. At this point the rough plate is raised and lowered by means of vacuum cups. It goes either to storage racks or to the grinding and polishing line.

On the grinding and polishing table the plate is embedded in plaster to hold it firm. Thirty grinder runners, using sand, give a smooth finish on one side and 60 runners polish the glass. It is then stripped from the tables, turned over with the polished side down and embedded in new plaster. The grinding and polishing operations are repeated on the second side of the plate. It is lifted and placed on the washing conveyor. After a thorough washing to remove dirt the glass is inspected, cut to the desired final size and packed for shipment.

Shipment of the plate glass is done either in box cars or on flat railroad cars. Automobile glass is packed in boxes and large glass is shipped in gondolas.

The accompanying pictures illustrate the essential steps in the process used at the Creighton plant of Pittsburgh Plate Glass Co.

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January, 1942

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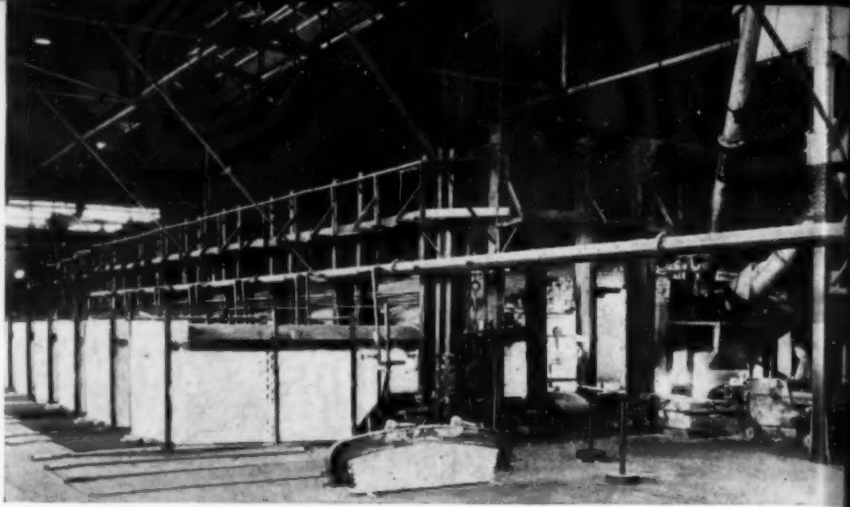
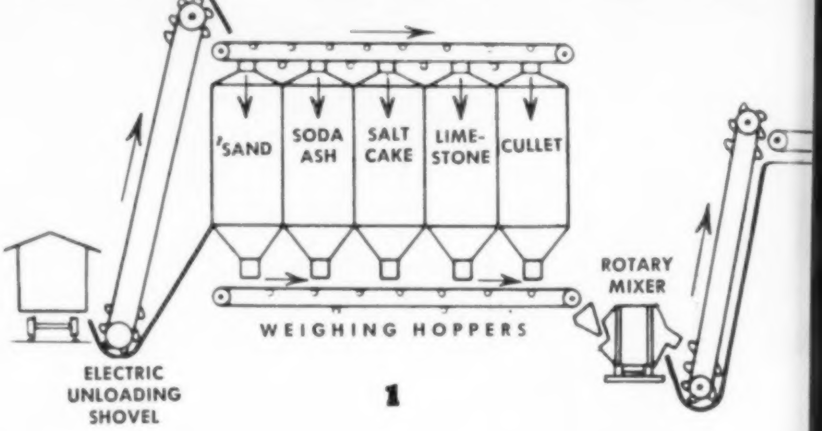
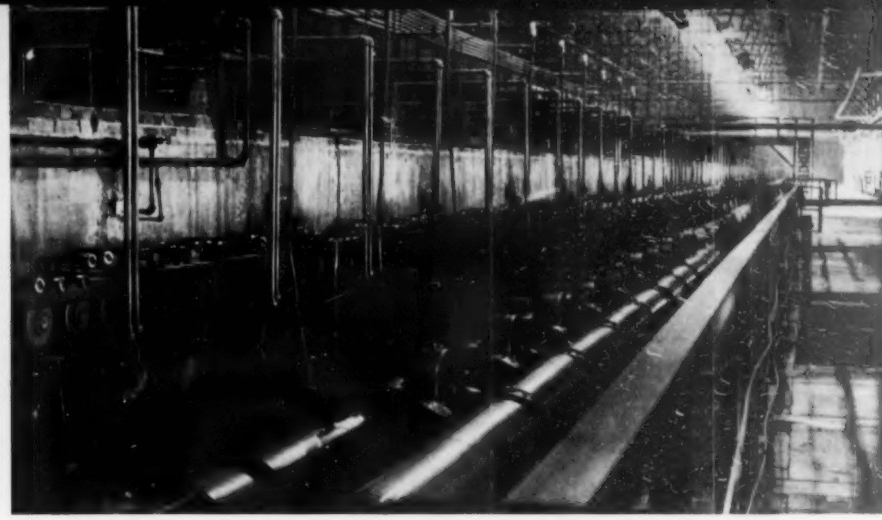


2 After mixing raw materials are conveyed to the batch hopper and then fed into the melting end of the furnace so as to keep a constant level of molten glass

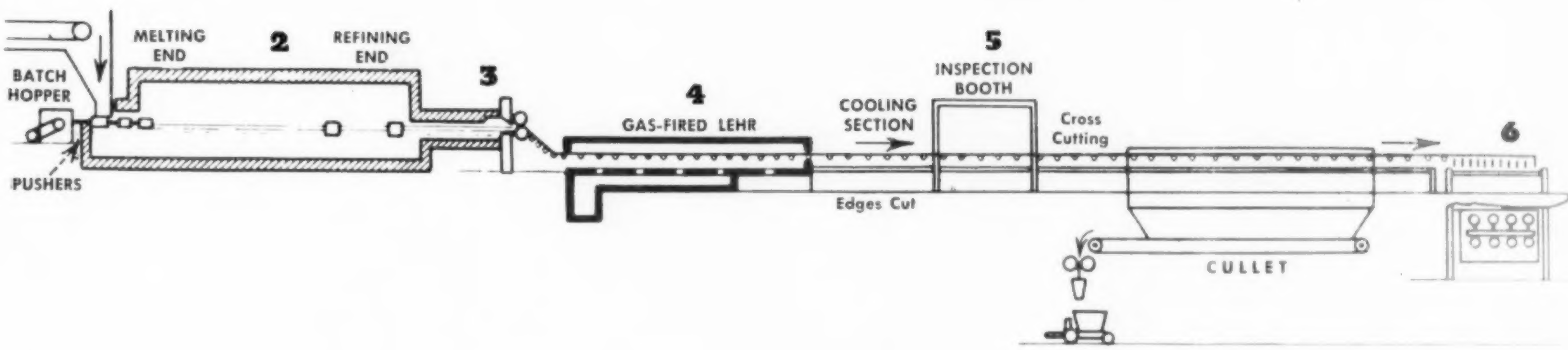


1 Raw materials, sand, soda ash, salt cake, limestone and cullet, are weighed at these hoppers before being carried by conveyor to the mixer

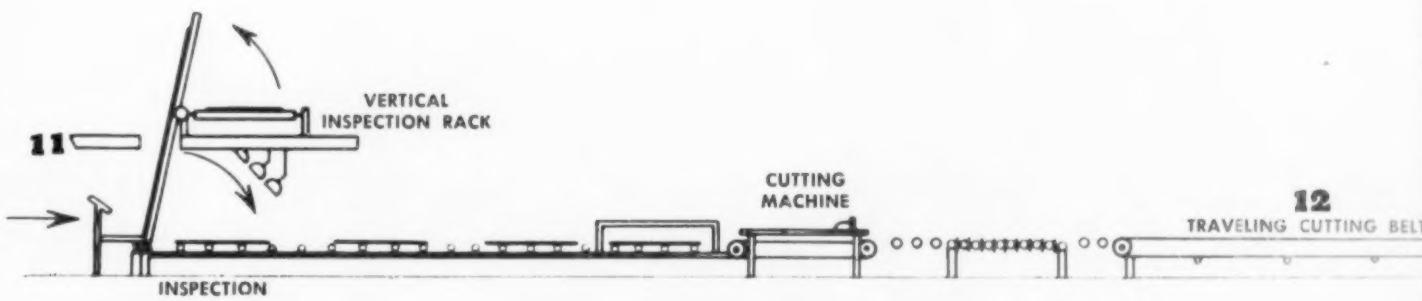
3 The melting tank has a capacity of 1,400 tons. The molten glass pours through the tank throat between rolls in the form of a ribbon



4 The glass ribbon is annealed in a gas-fired lehr 400 ft. long. Temperatures of the lehr are regulated at many points along the entire length of the tunnel



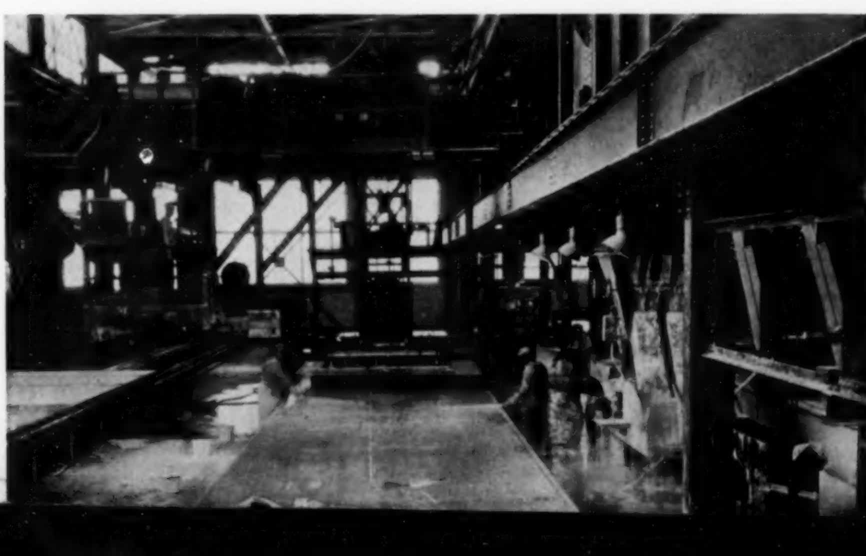
A *Chem & Met* **FLOW SHEET**

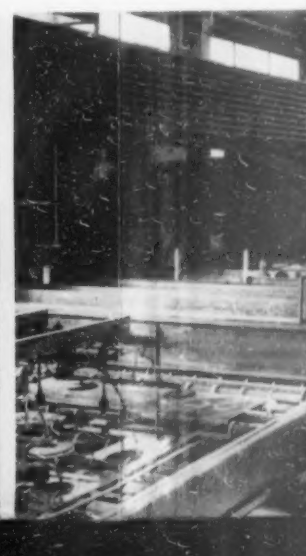


8 Beginning of the grinding and polishing line or table. Plaster is spread on the table and the glass embedded in order to hold it in position

9 About 30 grinder runners are used. Several emery runners give final smooth finish

10 One side of the plate hav over, and the grinding and po





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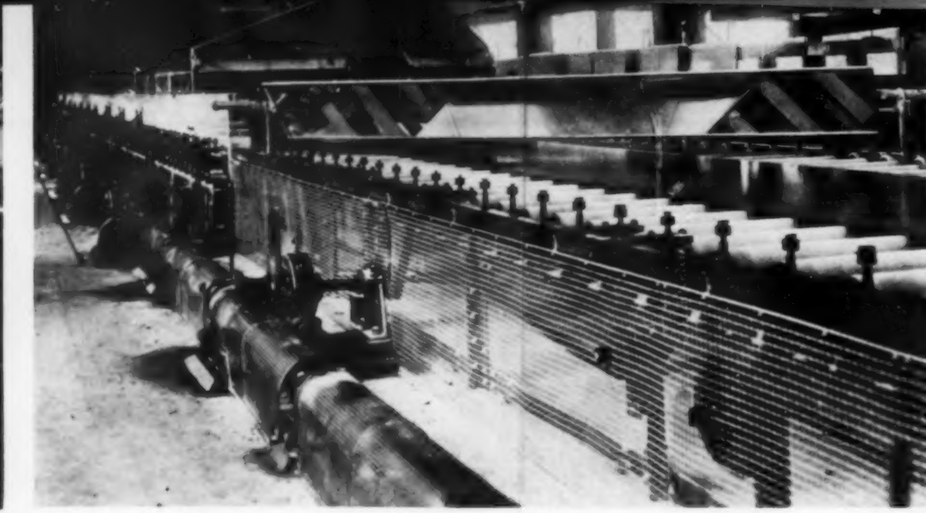
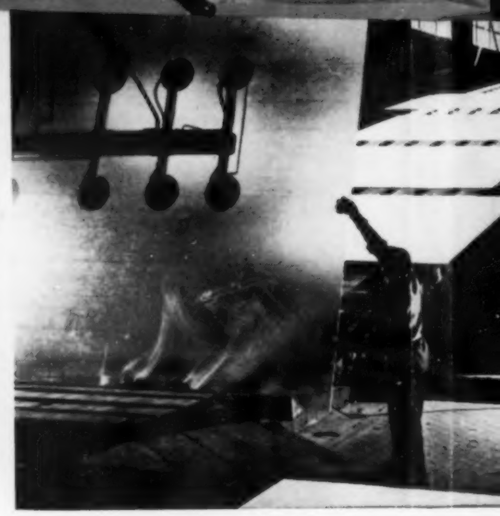
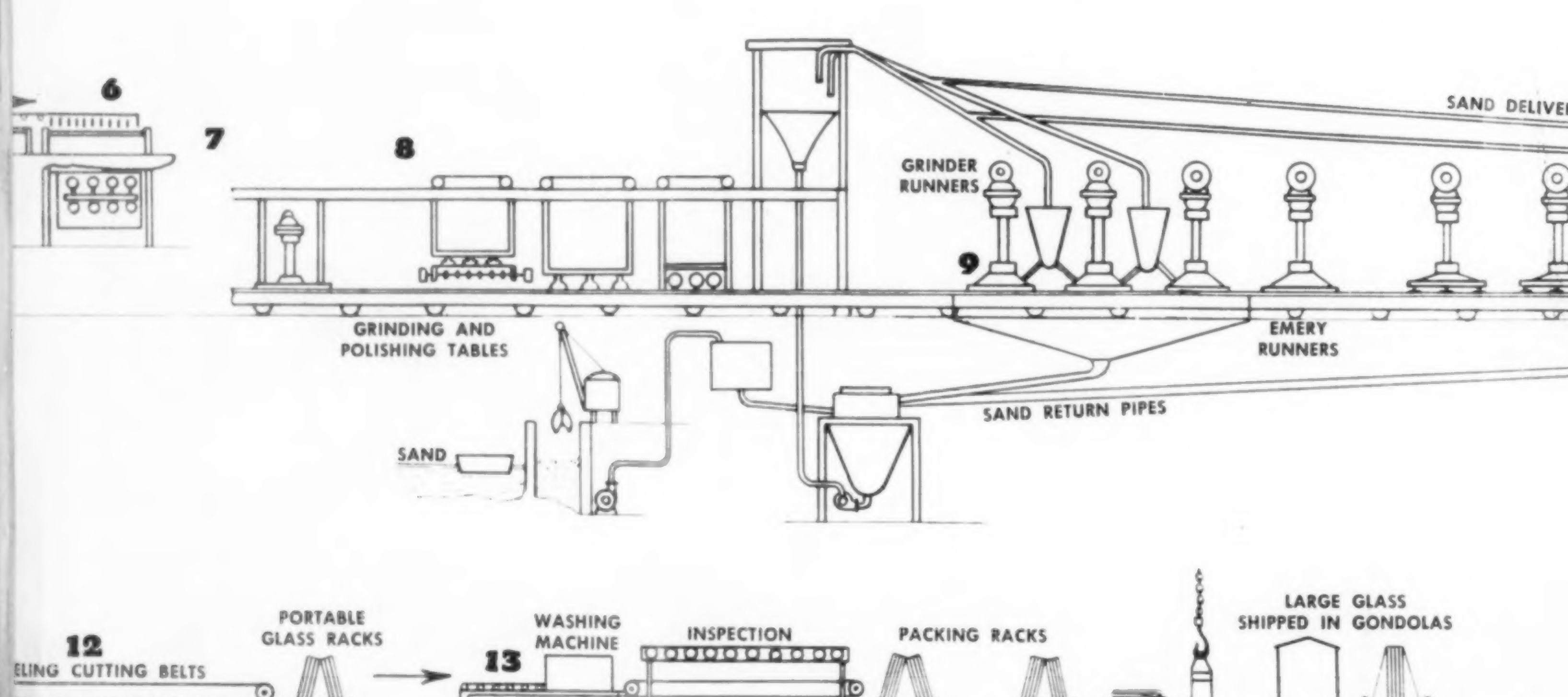


5 The ribbon is cooled and every square inch of it is given a careful visual inspection while passing through the inspection booth on the line

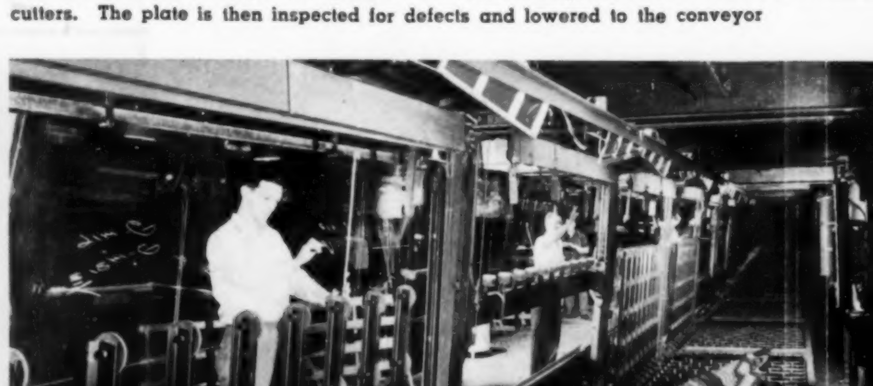


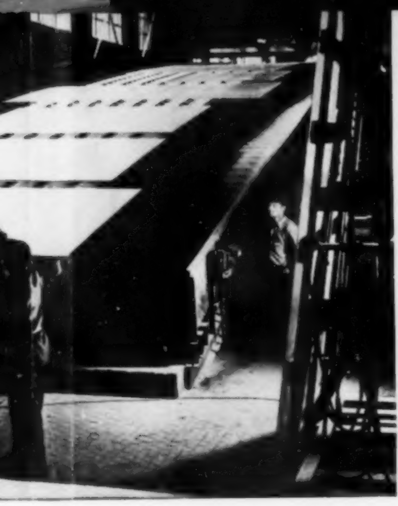
6 After inspection the ribbon is cross cut and sepa
falls into a hopper, is crushed, and conveyed back



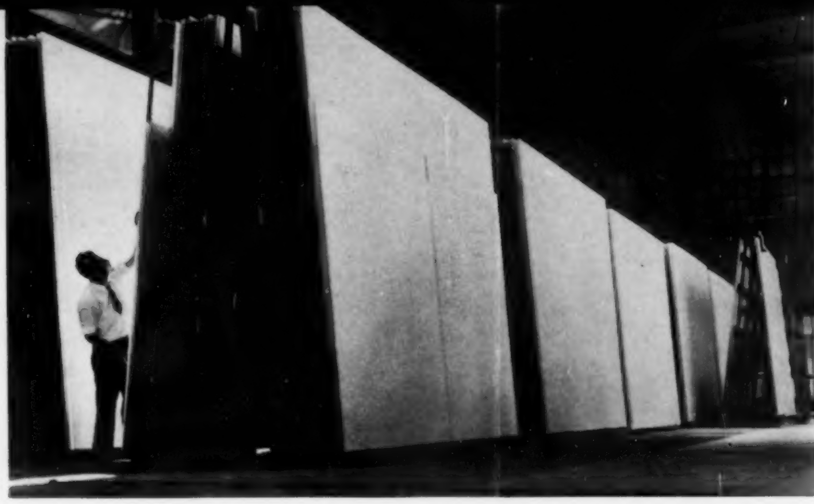
de of the plate having been polished is stripped from the table, turned
he grinding and polishing operations are repeated.

11 The washed glass plate is placed in a vertical inspection rack, where it is marke
cutters. The plate is then inspected for defects and lowered to the conveyor

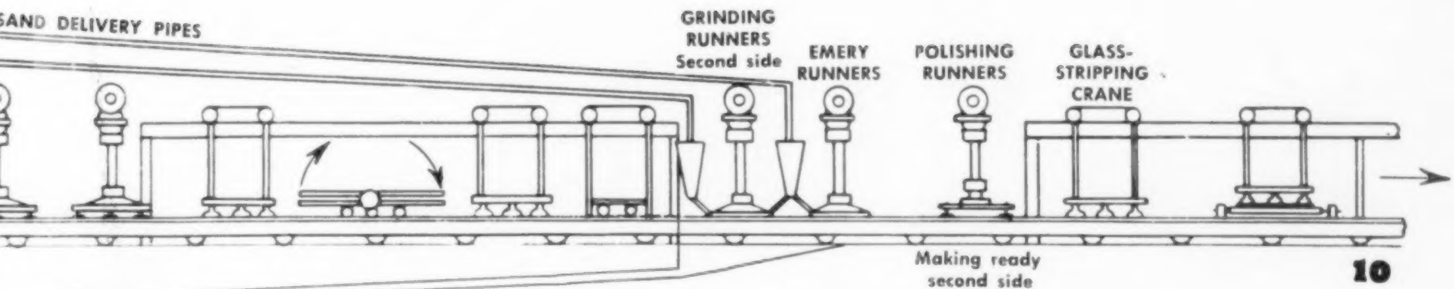




cut and separated into plates. Cullet
nveyed back to batch



7 At this point the rough plate is raised and lowered by vacuum cups. It goes either to storage racks, as shown, or to the grinding and polishing line



10

e it is marked for
or

12 Marked sheets or plates pass along the line to the cutting machine where they are cut into the sizes required by the customer

13 Portable glass racks convey the product to a washing machine. The glass is given another inspection and is packed for shipment

Technical, Industrial, Personal

CHEM & MET NEWS

ROSTER OF SCIENTISTS WILL INCLUDE COLLEGE SENIORS

The National Roster of Scientific and Specialized Personnel is now conducting a survey of the senior and graduate students of chemistry and chemical engineering in the universities of the country. It is urged that all persons with training in this or any other scientific or professional field register with the National Roster as soon as possible.

The registers of this organization, containing the names of the scientific and professional individuals of the nation, are of the utmost importance in our present crisis. They must be replenished and kept current in order that there will always be a supply of trained men and women to handle any situation or carry on any research which is essential to our war effort.

Registering with the National Roster is one way in which the trained individual can do his part. There may never arise an occasion where an individual would be asked by the Government to serve. On the other hand there may be a time when persons with certain skills will be vital to the welfare of the nation either as a full time worker, a part time worker, or as a consultant. Nothing has ever been lost through preparedness. Therefore, it is urged that all with special training register immediately. This can be accomplished by writing to Erle M. Billings, consultant, 343 State, Rochester, N. Y. and stating the field in which you are trained.

BUSINESS PAPERS WILL HELP IN WAR PROGRAM

Donald M. Nelson, executive director of SPAB, in addressing a group of business paper editors who met with him at his office on Dec. 19, said "America today is confronted with a task of converting industry into a machine for victory; and in this task the business press of the nation can play a most conspicuous part." Present at the meeting were: James Custer, Chilton Publications; Julien Elfenbein, Haire Publications; H. V. Kappel, Chicago; S. D. Kirkpatrick, *Chemical & Metallurgical Engineering;* G. F. Nordenholt, *Product Engineering;* H. C. Parmelee, *Engineering & Mining Journal;* H. J. Payne, F. W. Dodge Publications; Frank Steinbach, Penton Publications; George Taubeneck, *Business News;* Paul Trimble, Donnelly Publications; Douglas G. Woolf, *Textile World;* and Paul Wooton, McGraw-Hill Publications. These men will form the neucleus of an informal advisory committee which will cooperate with the Government in various phases of the war program.

After the conference with Mr. Nelson, the editors met with Robert W. Horton director of the information division of OPM who outlined ways in which the business press could be of great assistance in the nation's war efforts. Their publications, he said, could help industry conserve vital materials at the source and could also, through case studies and otherwise, speed up salvage campaigns. They could be the medium through which industry could share its knowledge.

CANADIAN PULP PLANTS EXPAND CAPACITIES

Pacific Mills Ltd., British Columbia pulp and paper manufacturers have been authorized to spend $585,000 on a new expansion program at their plant in Ocean Falls, B. C. The investment will enable the company to increase production of sulphite pulp from 120 to 145 tons daily, and to boost the output of kraft paper from 140 to 165 tons daily.

Ottawa has agreed to tax concessions to Pacific Mills on a basis similar to those already granted to Powell River Co., B. C. Pulp & Paper Co. and Sorg Pulp Co., which are undertaking expansion under government sponsorship. For purposes of income taxes and excess profits tax, a deduction of one-third of the sum of $585,000 is allowed Pacific Mills for each of the three years. Net returns would not be sufficient to justify making the investment required and assuming price fluctuation and after-the-war business risks without taxation concessions.

Announcement of Pacific Mills' plans brings to nearly $5,000,000 the amount spent or to be spent in the immediate future by the pulp and paper industry in this province. Powell River Company, which spent more than $1,000,000 on its new Lois River dam, is spending $1,313,000 in expanding its sulphite plant; B. C. Pulp & Paper Co. is increasing capacity of its mills at Woodfibre and Port Alice at a cost of $741,000; Sorg Paper Company is doubling production at the Port Mellon mill at a cost of $1,000,000; Westminster Paper Company has spent between $200,000 and $300,000 on improvements.

JUNIOR ENGINEERS TO MEET WITH NEW YORK SECTION OF A. I. Ch. E.

The Junior Chemical Engineers will meet jointly with the New York Section of the American Institute of Chemical Engineers at Child's Restaurant, 109 West 42d St., New York, on the evening of Feb. 9. The meeting which will be held at 8 o'clock will be preceded by a dinner. Dr. H. E. Howe, editor of Industrial & Engineering Chemistry will speak on "Chemical Priorities." As a special feature a Chemical Editors Round Table will be held with H. E. Howe, W. J. Murphy, and S. D. Kirkpatrick discussing the role of the chemical engineer in the present emergency.

ALCOHOL PRODUCTION AND USE UNDER STRICTER CONTROL

On January 6, the Office of Production Management issued an amendment to General Preference Order No. M-30 which imposes sweeping changes in the alcohol industry both from the standpoint of production and distribution. No restrictions were placed on deliveries of ethyl alcohol for military explosives, acetic acid, ethyl acetate, ethyl chloride, resins and plastics, health supplies, and other uses directly or indirectly connected with our military effort. Deliveries to civilian industries, however, are specifically prescribed in the order. For January its use must be reduced to 85 percent and in succeeding months to 70 percent of that for the corresponding months of the year ended June 30, 1941, in hair and scalp preparations, bay rum, shampoos, face and hand lotions, body deodorants, toilet waters, perfume, toilet soaps, shaving creams, mouth washes, tooth cleaning preparations, rubbing alcohol, vinegar, and candy glazes.

Referring to production, the order directs that no producer shall after January 15, produce ethyl or butyl alcohol from molasses unless his equipment and facilities capable of producing from corn or grain are being utilized to the fullest extent in producing ethyl or butyl alcohol from corn or grain.

Deliveries of isopropyl alcohol are subject to the same restrictions reported for ethyl alcohol but preferential ratings are assigned as follows: acetone, B-1; chemicals, chemical products and chemical processing, B-3; drugs and pharmaceuticals, B-5; anti-freeze, B-7.

A preference rating of B-8 is given to methyl alcohol for use as a denaturant or solvent but the amounts delivered monthly must not exceed one-twelth of the quantity used for such purposes in the 12-month period ended September 30, 1941. More drastic was the clause which prohibits the use of methyl alcohol for anti-freeze compounds after January 1 unless this production is to fill orders of government agencies or of outside countries which have working agreements with this country. This prohibition extends to stocks of methyl alcohol anti-freeze on hand when the order was issued.

OPM has issued an order directing that 60 percent of the distilling industry's capacity be diverted to manufacture of 190 proof ethyl alcohol from corn or other grain. The order becomes effective Jan. 15.

News from Washington

WASHINGTON NEWS BUREAU, McGRAW-HILL PUBLISHING CO.

All limitations on speed were removed in December by Washington planning. The president's decision to put war production on a basis of over $50 billion per year pictures accurately the hope of extreme measures in manufacturing and direct military action. All plants not on a basis of continuous day and night operation, regardless of Sundays and holidays, are expected to step up to that basis as fast as possible. Consumption of raw materials in final manufacture of munitions will, therefore, impose new burdens on chemical supply.

Full control of all materials, including chemicals, will, therefore, be imposed. The regulations prescribed for tin, copper, and rubber typify completeness of administrative supervision and allocation which are to be expected on many other goods. Washington is gratified at the public reaction to even these extremes for the acceptance of drastic rubber control, returning many folks to horse and buggy days of transport. It is taken officially to mean general public approval of this supreme effort and plan.

Ministry of Supply

At New Year's it was not evident how the President and spokesmen of allied nations would work out the program of administration. The pattern of inter-allied strategy and control undoubtedly will take form during January, perhaps before this issue of *Chem. & Met.* reaches its readers.

Working under the supreme inter-allied agency, the top American unit will be something comparable with the present SPAB. It will determine the whole program of economic warfare, and presumably administer much of it, as well as set the program for munitions production and determine the cuts in civilian supply necessary. Washington gossip indicates that Donald Nelson will continue to be the executive functioning at this top level, under the board which presumably Vice-President Wallace will continue to head.

Thus, it is evident that actual production policies must be put through two levels of authority, and then secure presidential approval, before the function of production, including material supply, begins. There is still considerable controversy as to whether this production effort will be made comparable with the ministry of supply of Britain or whether the rather clumsy O.P.M. system will be continued.

The delays which are being experienced during the holiday period have caused some criticism in the chemical fields. These, however, are the inevitable consequence of organizing an actual war program on a greatly increased scale. Pending decisions and orders, the advice given from Washington has been consistently, "You cannot plan on too big a scale for anything affecting military production. Go ahead with your plans at least tentatively and we'll use your output, probably want it long before it is ready for delivery."

Comparable encouragement is not being given to any type of manufacture where civilian usage of the ultimate product is anticipated. Naturally public health and safety projects are being encouraged to a maximum. But almost all other non-military applications seem, in prospect, to be headed toward the non-essential or postponable class.

The Army has shown official and vigorous objection to acceptance of a civilian ministry of supply. It appears, however, that the President has been impatient with the slow speed achieved by military purchasing and production officials. Furthermore, these men are needed for military jobs for which they have been trained. It will not be surprising, therefore, if an almost completely civilian production organization develops with comprehensive authority. Military men will then be used largely as advisers, with some veto power, to make sure that what the civilians get ready for Army and Navy use is an acceptable and usable product. "Diverting military talent to civilian purchasing and production function is silly," seems to be the New Year's motto in high places.

Metal Economy

Of outstanding importance to all chemical process industry is the pattern of metal conservation which has been developed by Washington. The copper program, which looked extremely drastic when promulgated in the late fall, is now a comparatively mild form of regulation as compared with controls established on tin and other scarce metals which must be obtained via the Pacific. The government has taken complete possession of imported materials of this class, the first orders identifying 15 commodities which no private person or company can import or own after the import, namely, antimony, cadmium, chromium, copper, graphite, kyanite, lead, mercury, rubber, rutile, tin, tungsten, vanadium, zinc, and zircon.

Distribution will be by allocation only in most cases. As soon as stocks in process are used, the manufacturer requiring these materials becomes completely dependent on Uncle Sam's bounty. The tin distribution program, scheduled for issue in early January, will be the pattern for further metal controls.

A division of O.P.M. continues to struggle with methods of metal saving. Substitution of the less scarce for the more rare is an obvious first step. Economy in use by simplification and standardization of types of product is the job of two branches of the Bureau of Industrial Conservation. Salvage of scrap, recovery, and prompt re-processing of secondary metal is an important unit of this same Bureau. Great emphasis is being laid on the importance of classification of scrap so that re-use can be accomplished with the minimum debasement of quality.

The government is urging that any manufacturer or user of the materials or equipment who can suggest ways to economize on scarce metals or chemicals do so promptly. Emergency changes in specifications are being granted promptly for that purpose where necessary, so long as the change in the specification does not decrease the military effectiveness of the product purchased.

Rubber Plans

The most serious immediate effect of the Pacific war is curtailment of rubber usage. Washington is gratified at the public reaction and has taken prompt steps to speed up means of remedy wherever possible.

It is anticipated that great reduction in civilian use of tires and other rubber goods will be necessary for a year or two. Tremendous increase in reclaimed rubber for official purposes is planned. A substantial quantity of reclaimed rubber will be allocated, along with nominal amounts of virgin material, to enable private owners of automobiles to have repaired, retreaded, or recapped tires so far as practical. New tires are going to be scarce indefinitely, probably for the Duration.

Synthetic rubber plants operating or building at the New Year are estimated to have a productive capacity of about 80,000 tons of product per year. This is roughly half privately owned and half Defense Plant Corporation capacity. Before Christmas orders were given to arrange for the tripling of the D.P.C. plant production. Negotiations to that effect were under way during the holidays. And even more important negotiations were started during December for the supply of the necessary butadiene, styrene, and other raw material chemicals. It is anticipated that several new companies will enter this picture shortly. Early in 1943 it is expected, therefore, that the productive capacity for synthetic rubber will approximate 160,000 tons per year. This estimate does not include such materials as neoprene.

On Jan. 12, D.P.C. authorized government expenditure of $400,000,000 to bring annual capacity of synthetic rubber up to 400,000 tons.

Priority Aids

Many more general priorities are being granted to industry groups to insure machinery and equipment, repair and maintenance, or raw material supply. O.P.M. has provided, for example, that all smelters, all petroleum refineries, and all of several other groups of industry plants shall have a very high priority for emergency repair, a slightly lower priority for supplies and materials needed to prevent emergencies, and a fair A rating for materials of construction needed for plant

maintenance or authorized expansion.

Comparable high ratings on raw materials have been provided for makers of industrial explosives, for the manufacturers of germicides, insecticides, and fungicides, and for raw material needs in several other divisions of process industry. Without such provision it is recognized that the vital supplies of materials needed for health or safety, agriculture, or further industrial manufacturing could not be maintained.

The main problem being experienced is that even a fairly high A rating no longer gets prompt delivery of goods from many suppliers or of equipment from many shops. To meet that problem, the government is now providing that when a shop is busy with certain classes of priorities, it is not always permissible to put in ahead of them a new priority order, even one of nominally higher rating, unless it can be shown that it is a direct Army and Navy necessity. Without that restriction it was evident that shortly a man could not expect to get anything unless he had an AA or an A-1 priority in many divisions of industry.

Chemical Orders

Numerous orders are being issued at frequent intervals fixing prices of chemicals or making more complete rules for chemical allocation. During December O.P.A. requested manufacturers to delay the fixing or announcing of price schedules on a number of important chemicals. The purpose was to leave those matters unsettled until the price ceilings could be promulgated as they were promptly on industrial alcohol, butanol, acetone, glycerine, and a number of others. The products of many process industries were equally controlled by price orders of December, including zinc pigments, coke, carbon black, sugar, certain fats and oils, Kraft paper, waste paper, and paper products. Several manufacturers or groups of manufacturers voluntarily agreed with O.P.A. to impose price ceilings on themselves, for example, for bleaches, pyrophosphate, and in one case, sulphuric acid.

Allocations have become complete on such commodities as chlorine, methanol, ferroalloys, and several other products of electrochemical or process industry. Rigid restrictions on purchase of fats and oils were also imposed during the last week of December, one order limiting purchase to 90 days' supply under certain circumstances. In a number of other cases the hardships imposed by earlier orders, notably on fat and oil users, were alleviated by special exemptions or modification of rules.

Generally speaking, however, controls on both price and usage of these and many other scarce commodities may be expected to grow.

Chemical Miscellany

Cut in Tariffs—Sharp cuts in sugar duty and the tariff on molasses were granted to Cuba in a December supplement to the trade agreement. These changes become effective in January. Other tariff cuts may come from negotiations with Iceland, mainly on fish by-products and fish oils. It has been proposed that all tariffs be waived by this country and Canada to facilitate military operations. Whether so drastic an action will be taken seems rather doubtful as 1942 begins. The opponents of this action say that it is wholly unnecessary as most of the tariff is mere bookkeeping anyhow when it relates to government business.

Trade Data—The government is not going to continue its normal printing of foreign trade data. Knowing current export and import figures helps our enemies too much.

Local Responsibility—Radical reorganization of the Office of Civilian Defense was scheduled for early January. Much misinformation and much loose administration has caused administrative difficulties and some technical complications. But thus far there is no evidence of complete centralization of authority. Much responsibility will remain with local business executives to see that adequate organizations are arranged and that the dangers of vigilantes are avoided. The responsibility for plant protection against sabotage, as well as against air attack, rests with individual managements. The government will help, but not boss this part of the job.

More Toluol—Satisfactory arrangements are being made by the Army to double toluol output at petroleum refineries. Construction of an additional $55 million TNT plant for West Virginia was announced on December 30. Getting the toluol is much the easiest part of this explosives job.

Hansgirg Arrested—Washington cannot discover just what is going to be done about the arrest of Dr. Fritz Hansgirg, the master mind of the Permanente magnesium process. It anticipates that the seriousness of the loss of this executive will be well evidenced by the vigor with which Henry Kaiser and his associates press their request for release of the eminent scientist. The arrest, made by FBI was presumed to have been in line with the routine check-up of aliens by the immigration authorities. However at the hearing held on Dec. 24 it developed that his wife had been writing to her son by a former marriage who was in the German army. This correspondence was shown to have been of an innocent character and the release of Hansgirg was recommended but final approval for this must come from Washington. In the meantime Hansgirg has been directing the work at Permanente from his place of detention through daily meetings with his secretary and several of the plant engineers.

Government Bureaus Move—Twelve government bureaus were ordered out of Washington mid-December, effective early in 1942. Subsequently it was arranged that only part of the Patent Office should so move. Those having dealings with the bureaus affected may continue to address them in Washington until stabilized in new locations. Sooner or later at least 20,000 government workers and their families are likely to be affected by this and further orders of exodus.

Mexican Adjustment—Commissioners have been named by the United States and Mexico who will undertake to determine the further money liability of the government of Mexico to petroleum companies whose property was seized. Preliminary settlements were admittedly only for a part of the values involved. The naming of Dr. Morris Llewellyn Cooke as the American commissioner indicates that a factual realistic approach is desired. Dr. Cooke is an outstanding engineer and is taking competent fact-seeking assistants with him to Mexico City for the beginning of negotiations in January.

Submarginal Mineral—Shortage of certain raw materials indicates the feasibility of temporary development of submarginal deposits. Washington is wondering whether glass makers may not have to use certain natural sodas for increased glass output as the capacity to make soda ash in the United States becomes inadequate. Some subsidy for such developments will be granted by Washington where necessary to get an important raw material.

Container Standards—Two new container specifications have been formulated by Manufacturing Chemists' Association for carboys and certain drums. This is a first step in the voluntary simplification program which will reduce the number and variety of chemical containers. It is hoped that the stock problem and times of delivery will be greatly benefited, to the advantage of both manufacturers and users. Substantial economy in the consumption of scarce materials is also accomplished in the new standards. This voluntary program will, it is hoped, prevent the need for any compulsory action such as that imposed on the petroleum industry.

Chemical Wages — On December 13 there was published the proposed new minimum wage standards for the chemical and related products industry. The Secretary of Labor then gave notice that 40 cents an hour in the Southern states and 50 cents an hour elsewhere would be the minimum permissible wage under the Public Contracts Act. It is anticipated that final formal action fixing these minima will come soon, as the protests entered have been almost negligible so far as the general program is concerned.

Patent Commission — The President announced on January 2 that he had named the following gentlemen to work with Secretary of Commerce Jesse Jones as a Patent Planning Commission: C. F. Kettering, Owen D. Young, Chester G. Davis, Edward F. McGrady, and Francis P. Gaines (President of Washington and Lee

University). The Commission is expected to recommend modifications required in the patent system to facilitate later change-over from war to peace.

Food Shortage — The government took note of the impending serious sugar shortage by purchasing the bulk of the Cuban crop at the year end. Some form of rationing is certain to follow soon. Industrial users of fats and oils would be much happier if there were any evidence in Washington of a comparable prompt action to stimulate new production of oil crops. It is anticipated that ultimately food oils, as well as drying oils and soap oils, will require some form of close control.

These problems, previously serious, have been greatly accentuated by the Pacific war which virtually cuts off both the United States and Britain from Australasian sources of sugar and fat. Lend-Lease buying to supply Britain promises, therefore, to aggravate the problem of domestic supply in the U. S., both of sweeteners and of fats and oils.

HOFFMANN SCHOLARSHIP GOES TO ROBERT T. OLSEN

The Hoffmann Scholarship of The Chemists' Club has been awarded for the school year 1941-2 to Robert T. Olsen, a candidate for the Ph.D. degree in the Department of Chemistry at Massachusetts Institute of Technology. This Scholarship, founded by the late Dr. William F. Hoffmann, is available in alternate years; the stipend is $800, payable in semi-annual installments of $400.

Mr. Olsen did his undergraduate work in the Newark College in Engineering, receiving the B.S. degree in chemical engineering in 1936. In 1937 Columbia University awarded him the M.S. degree in chemical engineering, after which he worked for two years with the Eastman Kodak Company, Rochester, New York. In 1939 he entered Massachusetts Institute of Technology as a candidate for the Ph.D. degree in chemistry. He is completing this work under the direction of Professor Ernest H. Huntress, and will be eligible for this degree in June, 1942.

He chose as his thesis subject for the B.S. degree "Design of a Plant for the Manufacture of Propanol-2," and "Etherification in Hydrotropic Solution" for his M.S. degree. His Ph.D. dissertation involves study in the field of syntheses of coumarones.

MINING CONGRESS WILL MEET IN CLEVELAND

The annual meeting of the American Mining Congress will be held at the Statler Hotel, Cleveland, on Feb. 6, according to an announcement by Julian D. Conover, Secretary of the Association. Members of the Mining Congress from all parts of the country will attend and sessions of the meeting will be devoted to discussions of policies for the coming year and the many problems of the mining industry in meeting war-time requirements.

Recently the entire mining industry of the nation, through its president Howard I. Young of the American Mining Congress, pledged all of its resources and energies to the successful prosecution of the war on the Axis nations. At the forthcoming meeting it is anticipated that the organization will discuss ways and means in which metal and fuel production can be stimulated to aid in the Victory program.

P. L. FROST APPOINTED SALES MANAGER OF INNIS SPEIDEN

Innis, Speiden & Co. has advanced Pinckney L. Frost to the position of manager of sales to fill the vacancy created by the recent death of H. Gordon Mackelcan. Mr. Frost's connection with the company began in 1921 when he was employed as office boy. Subsequently assigned to the sales staff, he later assumed managership of the Cleveland branch of the company, holding that position from 1928 to 1933 when he was transferred to the executive offices in New York in the capacity of assistant manager of sales.

Kaiden-Keystone

Pinckney L. Frost

Born in Buffalo in 1904, Mr. Frost was educated at Milton Academy, Milton, Mass. and at Roxbury Latin School. He later studied chemistry at Pratt Institute in Brooklyn.

FELLOWSHIPS IN METALLURGY OFFERED AT COLUMBIA

Through the bequest of the late William Campbell, for many years Howe Professor of Metallurgy at Columbia University, two fellowships have been established. They are awarded primarily for graduate study and research in the field of metallurgy.

The stipend of each Campbell Fellowship is fixed at the time of award by recommendation of the Campbell Fellowship Committee and will normally be an amount sufficient to meet the necessary living expenses of the incumbent of the fellowship.

Applications accompanied by certified transcripts of academic records, statements of proposed research projects and proposed fields of graduate studies should be filed with the Secretary of the University before March 1. Practical experience in metallurgy or previous graduate study is desirable. Application blanks and announcements will be forwarded to interested persons by the Secretary of the University on request. For other information write to Professor Eric R. Jette, School of Mines, Columbia University.

STANDARD OIL OPENS RESEARCH LABORATORY IN CLEVELAND

The Standard Oil Co. of Ohio's new research laboratory adjacent to Western Reserve University in Cleveland was formally opened last month with a public reception, and then immediately went into action on vital research problems linked directly to America's fight for victory.

W. T. Holliday, president, and other officers and directors of the company were hosts at the open house. Guests were ushered through a maze of special research and testing equipment by members of the 25-man laboratory staff headed by Dr. R. E. Burk, who is professor of chemistry at Western Reserve as well as director of chemical research for Sohio.

Five separate laboratories, a large engine testing room and cold room provided in the building combine practically every known facility for the development of higher octane gasolines, Diesel oils and other fuels; of new lubricating oils and greases; of better asphalt products, and new by-products of the refining process.

MORE FIELD OFFICES OPENED FOR WAR WORK CONTRACTS

Opening of two additional field offices to help qualified manufacturers obtain war work was announced on Dec. 31 by the Contract Distribution Division of OPM, bringing to 100 the total number of such offices now operated by the Division.

The new offices are in Madison, Wisc., at 405 Washington Bldg. with Clif E. Ives, State Director, acting manager and in Duluth, Minn. with Earl H. Pitney, manager.

OOSTERMEYER NEW PRESIDENT OF SHELL CHEMICAL

At the beginning of the year C. B. deBruijn, president of the Shell Chemical Co., resigned his office and retired from active participation in the company. J. Oostermeyer who has been connected with company for over twenty-five years in various capacities, vice-president since 1939, was elected as successor to Mr. de Bruijn.

Immediately Available—

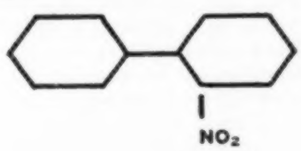
these two useful, low-priced intermediates!

HERE are two low-priced intermediates with great potential value—in new applications and to replace hard-to-get materials.

o-Nitrodiphenyl technical—available immediately in plentiful commercial quantities at 6¢ a pound—is useful in some applications as an alternate for substituted and unsubstituted nitrobenzenes.

o-Aminodiphenyl technical—equally plentiful at 12¢ a pound—can relieve the shortage of aniline oil for many manufacturers. It also may be used in resin compositions and in the manufacture of dyestuffs of the quinoline yellow and Hansa yellow types.

For samples, fill out and mail the coupon below. MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, St. Louis, U. S. A.



Molecular Weight: 199

o-NITRODIPHENYL
(Technical)

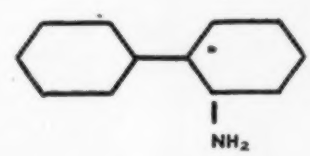
Appearance: Light yellow to reddish crystalline solid

Crystallizing Point: 34.5°C. Min.

SUGGESTED USES:

1. Intermediate in chemical synthesis. May be partially reduced and rearranged to give 2, 2'-diphenyl benzidine (NH_2=1).

2. Further nitration will give a dinitrodiphenyl which may possess interesting properties as a dyestuff intermediate.



Molecular Weight: 169

o-AMINODIPHENYL
(Technical)
(o-Phenyl Aniline)

Appearance: Purplish crystalline mass.

Crystallizing Point: 47.0°C. Min.

SUGGESTED USES:

1. In resin compositions.

2. In dyestuff synthesis to produce dyestuffs of the quinoline yellow series characterized by their fastness and a shade of yellow having a green tone. (U. S. Patent 2,211,662).

3. In the production of Hansa yellow dyestuffs through o-phenyl-aceto-acetanilid.

MONSANTO CHEMICALS

LET'S GO! U.S.A. KEEP 'EM FLYING!

MONSANTO CHEMICAL COMPANY
1704 South 2nd Street, St. Louis, Missouri

Please send me experimental quantities of ☐ o-Nitrodiphenyl technical ☐ o-Aminodiphenyl technical.

*Name*______________________________

*Firm*______________________________

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WAR REQUIREMENTS STIMULATE BRITISH INTEREST IN NEW CHEMICAL DEVELOPMENTS

Special Correspondence

FIRM price conditions prevail in British chemical markets, but there have been few advances lately, and authorities aim obviously at stabilization for the more common articles. Deliveries under contracts continue on a heavy scale, though in some directions—thus for certain coal-tar products—delays have been caused by uncertainties about official policy and consequent need for discussions with the responsible authorities. Rationing of consumers' goods begins to make itself felt in reduced calls from some quarters. Thus a decline has been noted in demand for textile chemicals, and consumption of dyestuffs has been curtailed by economies in the new color range. Rationing may become more directly felt when the official rationing scheme for fertilizers believed to be imminent is issued by the Ministry of Supply. Acreage, type of land, and crop will be taken into consideration for allocation of chemical fertilizers.

Among recent company formations are several of interest to the chemical industries. The United Kingdom Commercial Corp. (Portugal) Ltd. is a government-owned company with the special object of assisting British commerce with Portugal. The Anglo-Netherlands Incorporated Ltd. will, in spite of its small capital of only £200 play an important part in Dutch foreign trade; it is to establish agencies not only for the Netherlands Government but for the Netherlands Shipping and Trading Committee Ltd. and other Dutch bodies. The Therapeutic Research Corp. of Great Britain which has been formed with a capital of £500,000 counts among its founders such important makers of fine chemicals as Boots, British Drug Houses, Glaxo, May & Baker and the Wellcome Foundation. Its object is "to undertake and provide for the coordination and extension of research with a view to accelerating the discovery of new or improved substances for the service of therapeutic and preventive medicine."

Wartime economies will give Great Britain another new industry. When a plant now in course of construction will be completed, 15,000 tons of distilled secondary lubes will be available every year from the reclamation of used lubricating oils. The problems involved have been studied in a pilot plant for several years. The process developed there begins with uniform blending of the used oils. The resulting mixture is settled to segregate the major proportion of mechanical impurities and entrained water. The settled oil is distilled in the presence of a secret compound which is claimed to coagulate the finely divided carbon and other impurities remaining in the oil and remove the acidic and oxidized bodies which have been generated during its use. The compound also effects a certain degree of decolorization of the oil darkened from oxidation in use. Removal of the diluent takes place either under atmospheric conditions or, if necessary, in a vacuum in order to control the flash point. The plant is fitted with closed and free steam coils so that steam distillation can be carried out. Condensation of the very light products is effected by barometric condensers. The stills are fitted with a fractionation equipment which permits production of distilled oils to required viscosities and smaller re-run stills for production of the lighter petroleum products. All stills are operated on the batch system, each having a capacity of approximately 1,000 gal. per charge.

The search for "unbreakable glass" has derived stimulus from experience gained in actual flying conditions, and it is interesting to note that the material, now adopted by British aircraft designers as "bullet-proof glass" or the nearest approach to it available, combines two synthetic products, acrylic resins and cellulose acetate. The finished product is made up of two or more sheets of acrylic resin plastics with suitable adhesive coatings and intermediate layers of cellulose acetate. Compounding is done by means of a plasticizer spray and application of pressure varying between 50 and 200 lb./sq.in. according to the type of interlayer used at temperatures of 180-230° F. Moisture control is an important consideration in the process and necessitates sealing of the finished panels. Fluid pressure chambers replace the normal presses for the fabrication of curved parts. It is claimed that the optical quality is satisfactory even under extreme light and temperature conditions.

Lamination is the remedy also for another problem that has caused headaches among aircraft makers. In cases where sheet metal is unsuitable and plain plastics cannot be used because demand is too small to justify the expense of special molding equipment, manufacturers now avail themselves of a new material which consists of cellulose fiber laminations impregnated and bonded with special type adhesives. Initial tooling costs are low and molds can be altered at short notice. While not suited to the manufacture of flat or slightly curved surfaces, complex curvatures are easily and cheaply made from a wooden former. The whole process is mostly done by hand, though finishing begins with machine sanding and is followed by hand application of abrasives. According to investigations at the Royal Aeronautical Establishment at Farnborough, the material (which is called Pytram) has a tensile strength of 3,900 lb./sq.in., bolt hole tensile strength of 4,020 lb./sq.in., shear

strength 2,000-3,000 lb./sq.in., temperature range from 70 to 130° C, water absorption (without apparent deterioration) of 1.92 percent and a modulus of rupture bending of 5,960 lb./sq.in. Freedom from corrosion and electrical conductivity have opened up interesting outlets for the material.

Developments in Plastics

Two other developments in the plastics field are of general interest. A foamed modified urea formaldehyde glue is offered to plywood makers which, it is claimed, overcomes the swelling experienced when normal urea formaldehyde resins are used in the manufacture of very thin veneers. I has the additional advantage of low cost, as only a very thin coat is needed and a low pressing temperature (90° C) which obviates the risk of overheating the wood. The consistency of the foam is similar to that of the lather from shaving soap. The other new development concerns a special phenolic resin solution which has been introduced to users of cellulose acetate for the protection of that material against weather influences. The solution is supplied in three separate parts—lacquer, catalyst and thinner—which must be mixed before use and has another drawback in that drying and full hardening take a very long time. On the other hand, it is claimed to yield a tough, resilient film with high resistance to water, solvents and chemicals. It is used mainly where the cellulose acetate is exposed to wide fluctuations in temperature and humidity, where the "drying out" of the plasticizer may cause shrinkage, or where volume or weight changes may be brought about by other means. Use of this protection is claimed to have proved superior to curing or maturing of the cellulose acetate by thermal processing.

The use of sodium pentachlorphenate is recommended for treatment of cooling water in gas works as a protection against organic fouling. It is added to the water in the form of briquettes which slowly dissolve, the initial dose being 30 lb. per 100,000 Imp. gal. of water. During operations 10-20 p.p.m. of sodium pentachlorphenate are said to give good control of slime and algae formations. It is claimed to be quite stable, not to be volatilized, oxidized or otherwise changed by aeration, to be freely soluble in water and not corrosive to metals used in engineering construction, and to be without effect on other treatments that may be given to the water, for instance in order to prevent corrosion or scale deposition, but the water must not be used for drinking or bathing. Treatment of the water starts with an initial dose of about 30 p.p.m., and the chemical concentration is then gradually reduced over a period of two weeks or so by decrements of 5 p.m.m. until the algae growth just begins to reappear. The concentration is then increased by about 5 p.m.m. and maintained at that level by addition of sodium pentachlorphenate.

CONTINENTAL EUROPEAN CHEMICAL DEVELOPMENTS

Special Correspondence

Editor's Note: *Cut off from direct correspondence with all except a few foreign sources in neutral countries, these notes interpret recent developments in continental Europe as reported in a wide range of publications and official documents received in the United States prior to our declaration of war. These monthly letters, prepared in this country, will be continued only so long as pertinent material of interest to American chemical industry is available for our comment and interpretation.*

PLANS for integrating the chemical industry of the continent under German domination moved ahead another step when I. G. Farben-industrie announced last month that it has obtained control of three leading French chemical concerns. Included in the latest transactions are Etablissements Kuhlmann, Paris, Société des Matieres Colorantes de Saint-Denis, and the Société de Produits Chimiques of St. Clair du Rhone.

Kuhlmann, the largest of the three, has over 20 plants in France, exclusive of affiliates, controls French dye production, and is a leading manufacturer of heavy chemicals, glues, synthetic resins, solvents, fertilizers, insecticides, pharmaceuticals and drugs. In collaboration with mining concerns, Kuhlmann is the biggest synthetic nitrogen, nitrate and nitric acid producer in France. Although recently the trend has been toward concentration in a few larger concerns, the general rule has been to have many small and medium-sized plants, distributed all over France but with centers around Paris, Marseilles, Lyons, Rouen, and the northern coal mines. Between World War I and II France's chemical output expanded to rank only behind that of the United States, Germany, and Great Britain. Although an important world producer, France was not as active in international chemical trade. With the exception of potash products, chiefly from Alsatian mines, and of specialized coal-tar dyes, drugs, soaps and perfumes, most French chemical output has been for home consumption and not for export.

I. G. Farben is also reported to be participating in setting up a nitrogen industry in Spain. The development of a chemical industry there was checked by the Spanish civil war when many plants were destroyed or went out of operation. At present at least one million tons of imported fertilizers, nitrogenous and phosphatic, are badly needed in Spain. For national defense as well as agricultural needs, plans have been under way for some time to construct plants, but even with German help it will be several years before Spain can meet its requirements.

Increased German interest in Spain's resources can be deduced from recent articles in Reich chemical publications. Spanish pyrites, mercury and other minerals as well as oranges and cork are among the products in which chief interest is shown. Germans are competing with the British to obtain the largest part of Spain's orange exports this year, while they are bidding against United States interests and reputedly applying pressure to obtain the largest share of cork exports.

Even though various substitutes for cork have been tried in the Reich and great hopes held for the new "Iporka," synthetic insulating material for large refrigerators, natural cork is still indispensable for many uses. However, in the case of linoleum, where considerable amounts of ground cork have been used, Germans claim that a very satisfactory substitute floor covering has been found in "Mipolam." A vinyl polymer, it has been in use for the past five years in the form of tubing, film, sheets, and plates. Since Mipolam is resistant to ageing, heat, light, and oxygen, and does not lose its elasticity or sound-deadening qualities, it is being widely used as a floor covering in chemical factories, laboratories, hospitals, banks, theatres, stores, restaurants, and hotels. Since it is unaffected by sea water and is not flammable, and is odorless, resistant to mold and bacteria, and very resistant to abrasion, it is also being used for inside decks in shipbuilding. Highly decorative effects can be obtained since the product is made in many colors. It must be carefully laid, however, and special adhesives, such as "cosals" and "lucrylans," also polymerization products, must be used. According to an account in the publication "Kunststoffe," Mipolam floors in use have shown excellent wearing qualities and have not developed cracks or pores, and have an advantage over other floor coverings in that they already have a high gloss finish, requiring little or no waxing, and can easily be cleaned with cold or lukewarm water and usual cleansing agents.

In 1940, according to G. Matulat of the Reich chemical office 70,000 tons of plastics were used in place of metals in Germany. Thereby an estimated 300,000 tons of iron, steel, and nonferrous metals were released for other purposes. From 1936 to 1940 the output of phenol-cresol molded plastics increased by 125 percent, of phenols and cresols obtained from tar acids of coke and gas plants by 150 percent. The production of polymerized synthetics was five times greater in 1939 and ten times greater in 1940 than it had been in 1935.

"Vinidur" is the new collective group name for products marketed under the names "Mipolam," "Decelith," and "Igelit PCU." In sheet form it is being widely used to line large iron pipes as well as containers of wood, concrete, or masonry.

Despite progress with synthetic rubber, German chemists admit that they have not yet succeeded in producing an entirely satisfactory non-fading, tasteless, or odorless "Buna." According to the "Gummi Zeitung," Buna can now be used successfully for making dipped goods such as seamless gloves, nipples, etc. However, for thinner dipped goods like surgeons' gloves, where strength, thinness, and elasticity are essential, natural rubber must still be largely used. It has been found that balloons for children and advertising can also be made satisfactorily of Buna, but production of this item has been prohibited until after the war.

Gaskets of Buna are replacing gaskets of asbestos, which has to be imported. Since Buna resists heat and oils and stiffens rather than softens at high temperatures, it is claimed to be quite satisfactory. To make the gaskets, three sheets of synthetic rubber are sandwiched with two layers of steel wire netting, which are placed at 45 deg. angles to each other. Buna gaskets are reported to have better holding properties than the usual gaskets and can resist hot water and hot oil up to 350 deg. and can resist glycol, regular gasoline, and leaded gasoline.

Buna production figures are being kept a military secret, and there is no way of ascertaining how much damage was done by recent bombings in which the British claim hits on the large Buna factory at Huls in the Rhineland. There is also no way of knowing what percentage of German automobile tires is now made of Buna.

Two recent innovations in the manufacture of tires are reported in Germany. Alfred Spencker has patented (DRP 689 959) a new soft rubber air-cooled solid tire for trucks of two and one half tons. The new tire effects a saving of 10 to 15 kg. of rubber per tire, and the innovation is a floating air suction head at the hub of the wheel which leads cooling air through radial channels to the periphery of the tire tread. Tested at speeds of 120 km. per hour the inner and outer temperature of this puncture-proof tire was claimed to be lower than that of any pneumatic tire.

The other new development is a steel cord instead of a textile cord for pneumatic truck tires. Fine strands of wire are placed in layers at 45 deg. angles like normal textile cords, except that the wires are placed farther apart than the threads. The added weight of the steel wire in the carcass is offset by the fact that where normal truck tires require 12 to 14 plies of cotton, only 4 plies of steel wire are necessary. The steel cord type tires are claimed to be satisfactory in operation although the average tire temperature is somewhat higher than for cotton cord tires, and it is planned to start turning them out soon in mass production.

Buna and synthetic resins and other substances insoluble in water are being used increasingly as leather substitutes

(Please turn to page 136)


DICALITE

PERSONALITIES

✦ Roger W. Stoughton has resigned his position with the Department of Pharmacology at Vanderbilt University School of Medicine and has accepted a position with the Mallinckrodt Chemical Works, St. Louis. Dr. Stoughton received his Ph.D. degree from the University of Illinois in 1932.

✦ Francis H. Thurber, formerly of the Bureau of Chemistry and Soils, is now with the Southern Regional Laboratories at Laurel, Miss., where he is supervising plant operations in connection with the manufacture of starch from sweet potatoes.

✦ Albert H. Pedler left the Cyprus Mines Corporation, Skouriotissa, Nicosia, Cyprus, due to the war conditions. He is now with the Phosphate Recovery Corp. at Mulberry, Fla.

✦ J. Gerald Wisler has given up his fellowship at Michigan State College for a position with Hercules Powder Co. at Wilmington, Del.

✦ William A. Stanton is now located with the duPont Film Co. at Parlin, N. J.

✦ T. F. Scholz is now with the Calco Chemical Div. of American Cyanamid Co. at Bound Brook, N. J. Dr. Scholz received his Ph.D. from Yale University during the last school year.

✦ Charles A. Reichelderser has joined the research staff of Battelle Memorial Institute, Columbus, Ohio, where he has been assigned to the Division of Non-Ferrous Metallurgy. Mr. Reichelderser is a graduate of Purdue University. Prior to joining the Battelle staff he was associated with the Jones & Laughlin Steel Corporation, Pittsburgh.

✦ Nat Bailey, formerly chief chemist of Waukegan Coke & Chemical Co., has been appointed research chemist by the D. W. Haering & Co., Chicago. Other chemists who have recently been appointed to the Chicago Service Laboratory are Tom Palen and Jarvis Johnson. Dr. Dyer B. Lake has been placed in charge of the New York Service Laboratory.

✦ E. L. Reed has been added to the staff of the Foote Mineral Co., Philadelphia, as project engineer to do research and development work on milling and concentration problems. Mr. Reed was graduated from the University of Michigan as a chemical and metallurgical engineer and was formerly with the U. S. Gypsum Co. in the capacity of quality supervisor and research chemist. He also spent a number of months doing exploration and underground mining of lead and zinc ores for the Eagle-Picher Mining and Smelting Co.

✦ John G. Kura has been named to the technical staff of Battelle Memorial Institute, Columbus, Ohio, where he has been assigned to metallurgical research. Mr. Kura attended the University of Pittsburgh and is a graduate of Carnegie Institute of Technology. Prior to joining the Battelle staff he was associated with Carnegie-Illinois Steel Corporation at Duquesne, Pa.

Howard E. Fritz

✦ Howard E. Fritz, who for the past seven years has directed the development and sale of Koroseal, has been named director of research of the B. F. Goodrich Co. Dr. Fritz came to Goodrich in 1925 from the engineering school faculty of Ohio State University, where he was graduated in 1914 with a degree of Bachelor of Science in chemical engineering, qualified for the degree of chemical engineering in 1920 and received his doctor's degree in 1921. When he joined the Akron company, Dr. Fritz was placed in charge of a small department engaged in bonding rubber to metal. Under his leadership, this division grew to the extent that it was frequently referred to as an industry within an industry. In his new position, Dr. Fritz succeeds James W. Schade, company research director since 1925.

✦ James W. Schade, director of research of the B. F. Goodrich Co., since 1925, has retired. Mr. Schade joined the company in 1909 as a chemist, assuming direction of technical work in the footwear department. In 1922 he was chosen to direct operations of the company's testing laboratories.

Mr. Schade graduated from Cornell University in 1904 and remained for a year teaching chemistry.

✦ Robert C. Bour, formerly development chemist for Ditto, Inc., has joined the staff of the Chemical Engineering Section of Armour Research Foundation, Chicago, Ill., where he will conduct research in the field of paper coatings and food wrapping materials.

✦ Clark E. Thorp, formerly in charge of research for Ozo-Ray Process Corp., has joined the staff of the Chemical Engineering Section of Armour Research Foundation, Chicago. His work will be concerned with unit processes and pilot plant development studies.

✦ Clyde W. Leaf, formerly connected with Givaudan-Delawanna, Inc., has been appointed organic chemist in the Chemical Engineering Section of Armour Research Foundation. A graduate of Columbia University, Dr. Leaf's new research will form a link between problems in chemistry and metallurgy.

✦ G. J. Callister, for so long associated as vice president and secretary of the American Potash Institute, has been appointed as general secretary of the Canadian Society of Technical Agriculturists for the duration of the war, assuming the duties of C. Gordon O'Brien, who was called into active military service in October.

✦ A. R. Ellis, of Pittsburgh Testing Laboratory, has been elected president of the American Council of Commercial Laboratories, a group of independent laboratories whose equipment and personnel cover all fields of industry which have need of independent laboratory services.

✦ Albert H. Cooper has returned to the Virginia Polytechnic Institute, Blacksburg, Va. after a year's leave of absence when he served the Chemical Warfare Service at Edgewood Arsenal. Dr. Cooper is associate professor of chemical engineering at V.P.I.

✦ Larkin H. Farinholt, associate professor of chemistry at Washington & Lee University, is on leave of absence. Dr. Farinholt is serving as secretary of the Explosives Research Laboratory Committee of the National Defense Research Committee and is located at Pittsburgh, Pa.

✦ J. Joseph McDermott of Duke University has been added to the staff of the chemistry department of Washington & Lee University. Dr. McDermott is serving as instructor in the department.

✦ E. A. Turner, for more than 15 years in charge of Monel and rolled nickel sales in the chemical and associated

fields for The International Nickel Co., has been appointed to the post of assistant to sales manager, J. F. McNamara. Mr. C. J. Bianowicz succeeds Mr. Turner.

✦ Paul Hodges, formerly superintendent of Florida Pulp & Paper Co. and Brunswick Pulp & Paper Co., is now assistant to K. O. Eldekin, production manager of Crossett Paper Mills, Crossett, Ark.

✦ Frank S. McCall is technical director of the Herty Foundation Laboratory, Savannah, Ga. He was chief chemist of the Ford Laboratory at Savannah, and at one time was employed in the laboratory working under Dr. Charles Herty. Mr. McCall is a graduate of Virginia Military Institute. Mr. William F. Allen, who had been in charge of the laboratory, has joined the Staley Manufacturing Co. at Decatur, Ill.

Per K. Frolich

✦Per K. Frolich, director of the chemical division, Esso Laboratories of the Standard Oil Development Co., Elizabeth, N. J., has been elected president of American Chemical Society for 1943. Professor Arthur J. Hill of Yale University and Dr. E. R. Weidlein, director of Mellon Institute, were chosen directors. Dr. Charles Allen Thomas, director of the Thomas & Hochwalt Laboratories, Dayton, Ohio, research division of Monsanto Chemical Co. was named director-at-large. New councilors-at-large are: Dr. George D. Beal, assistant director of Mellon Institute of Industrial Research; Dr. Gustav Egloff, director of research of Universal Oil Products Co., Professor Henry Gilman of Iowa State College and Professor Carl S. Marvel of the University of Illinois.

Dr. Frolich was born in Christiansand, Norway in 1899 and was graduated from the Norwegian Institute of Technology in 1921. He received the degree of master of science from the Massachussets Institute of Technology in 1923 and the degree of doctor of science from the same institute in 1925.

✦ H. BENNETT of Crowley & Bennett, Chicago and Brooklyn, is in Cuba on an extended trip through the entire island in connection with the introduction of processes for byproduct recovery in the sugar and tobacco industries.

✦ ROY C. NEWTON, vice president in charge of chemical research, Swift & Co., Chicago, was placed in the hall of fame of his alma mater, Oklahoma Agricultural and Mechanical College in special ceremonies commemorating achievements of alumni, December 15. The occasion was part of a three-day observance of the 50th year of the founding of the college. Dr. Newton, member of Swift & Co. chemical research staff since 1924, was born in El Reno, Okla. in 1896 and was educated in the public schools of that city. He received his bachelor's degree from Oklahoma A. & M. College in 1921, having served in the A.E.F. in 1917-18. Following his graduation, Newton served as assistant chemistry instructor at the college and later taught at Purdue University and Lewis Institute. He received his doctor's degree from the University of Chicago in 1924.

✦ FRANK W. BUTTERWORTH, president of the Western Brick Co., Danville, Ill., was initiated as honorary member of the University of Illinois Chapter of Keramos at its recent meeting. This is a National Ceramic Engineering Fraternity for recognition and encouragement of superior scholarship. From time to time it is the practice to confer this distinction upon men who have made outstanding contributions to the ceramic industry. Mr. Butterworth is and has been for several years a member of the advisory committee to the Department of Ceramic Engineering.

✦ IVOR GRIFFITHS, technical consultant of John B. Stetson Co., Philadelphia, has recently been honored as being chosen president of the Philadelphia College of Pharmacy.

✦ J. E. BLACKBURN was elected a vice-president of the McGraw-Hill Publishing Co. by the Board of Directors at its meeting December 22, effective January 1, 1942. Mr. Blackburn will continue to head the circulation department of the company.

✦ GEORGE ACUNA is now director of the export department of the Orbis Products Corp., New York, N. Y.

✦ CHAPLIN TYLER, who has been head of public relations for the Remington Arms Co., Bridgeport, Conn., has been transferred to the development department of the E. I. du Pont de Nemours & Co., Wilmington, Del.

✦ J. OOSTERMEYER has been elected president of the Shell Chemical Co., affiliate with the Shell Union Oil Corp. He succeeds C. B. de Bruijn, who has retired after 33 years of service with Shell. Mr. Oostermeyer was made vice-president of the company in 1940 after

having been affiliated with the organization for 23 years.

✦ Walter J. Risley, Jr., staff assistant to the director of manufacturing of the Curtis Publishing Co., was appointed principal industrial specialist of the magazine section. Mr. Risley has been connected with the company for 18 years, specializing in technical problems affecting magazine production. He graduated from the chemical engineering department of the University of Illinois.

Wilson T. Lundy

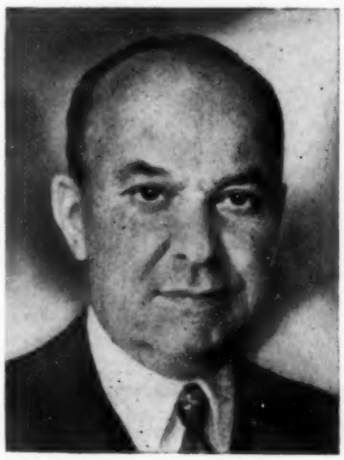
D. T. McIver

✦ Wilson T. Lundy, vice president of Freeport Sulphur Co., has been elected a director and D. T. McIver, assistant general manager, has been named general manager in charge of the company's sulphur operations. Mr. Lundy, whose mining career has taken him to Canada and Korea as well as through Western United States, has supervised production at three different sulphur mines for Freeport. Since he joined the organization in 1923 he has been vice president and general manager since 1930. In his new capacity, Mr. Lundy will be transferred to the company's head office in New York City. Mr. McIver who succeeds Mr. Lundy at the company's operating headquarters in New Orleans,

has been associated with Freeport for 18 years. In 1936 he was placed in charge of land and leasing developments and three years later was made assistant general manager with general executive duties.

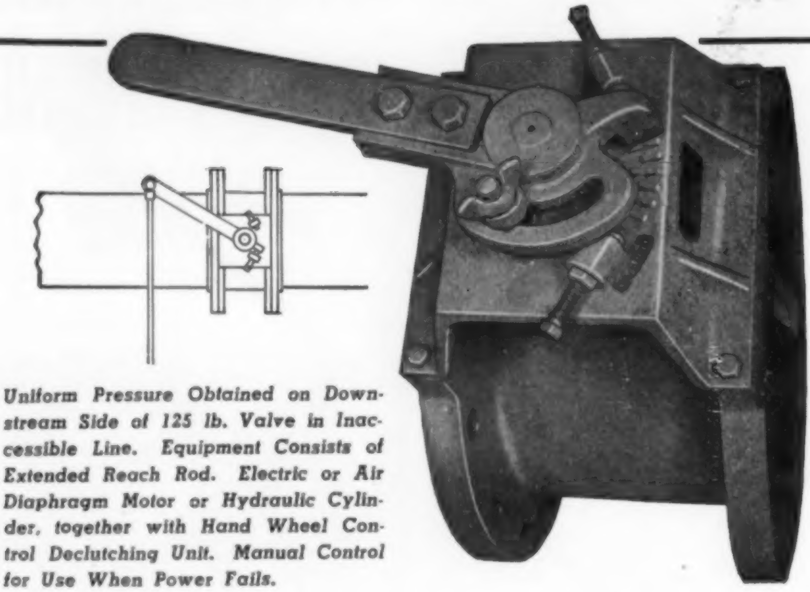
OBITUARY

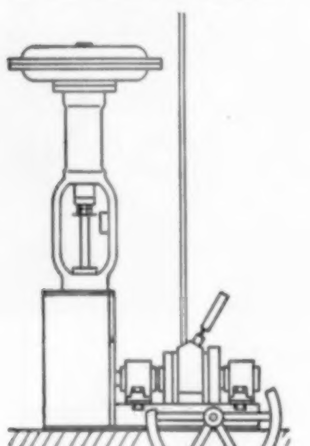
✦ Alexander Lowy died December 25, after an illness of four months. He was born in New York City 52 years ago. Graduating at Columbia University in 1915, where he conducted research work in electrochemistry until 1918 when he joined the faculty of the University of Pittsburgh. He was the holder of many patents on chemical research, was vice president of the Electrochemical Society from 1930 to 1933 and from 1939 to 1941, and also had headed the Society's publicity committee since 1931. He served as chairman of the Pittsburgh Section of the American Chemical Society and was a member of the American Association of the University Professors.



Howard S. Evans

✦ Howard Salisbury Evans, aged 65, died of a heart attack at his home in Pittsburgh Pa. on the morning of December 14. He had spent the greater part of his business career in the glass manufacturing industry. His first association with the industry was when he entered the employment of the Thomas Evans Co. of which his father was president, and the firm, a pioneer Pittsburgh institution, was engaged in the manufacture of lamp chimneys. When the Evans and MacBeth interests were merged into the MacBeth-Evans Glass Co. in 1899, Mr. Evans became associated with the firm. Mr. Thomas Evans became president and on his death in December, 1923, Mr. Howard Evans then vice-president moved up. He then continued as president until 1926 when he retired and Mr. George D. MacBeth was elected president of the company. Mr. Evans also was one of the founders of the Diamond Alkali Co. of Pittsburgh, and a member of its board of directors.





EUROPEAN DEVELOPMENTS

(Continued from page 129)

in the so-called "Nifarine" group. Nifarines consist of the aforementioned substances mixed with sawdust, tar, and mineral products, and are used for making shoe soles, packing materials, heavy bags, trunks, etc. The "Fabinettes" are another group of artificial leathers in the Reich which likewise find use as substitute shoe leather. They contain rubber latex, reclaimed rubber or buna as binders along with various animal, vegetable, or artificial fibers, or shredded leather. The oldest and best developed leather substitutes in Germany are the "Fagelanes," which are based on fabrics coated with water insoluble substances including drying oils, butadienne derivatives, cellulose lacquers, acryl resins, and other synthetics. Products of these three types of artificial leather are being used increasingly by saddlers, upholsterers and leather bag makers.

Buna and similar products are also being used to make shoe soles. Soles of buna are claimed to show better resistance to wear, water, and cold than those of synthetic resins. They have the disadvantage, however, that they make the feet hotter in warm weather, and cannot be as easily and firmly attached to the shoe uppers as synthetic resins. Other materials are also being pressed into service for shoe sole material. In Hungary it is reported that shoe soles made of aluminum plates have proven relatively satisfactory. The French are using German processes to make flexible wooden shoe soles by mixing sawdust, waste rubber and various synthetic substances.

Textile shortages are reported to be growing more acute in the Reich as well as on the rest of the continent this winter. Recently the Reich asked civilians to contribute clothing to be used by soldiers fighting in Russia. In France, Spanish broom is being processed as a fiber to make rough blankets.

Turkey remains as one of the few potential, though small, sources of natural fibers. It is of interest, however, that in the recent Turkish-German trade agreement it is stipulated that Germany must supply Turkey's orders for 18 million pounds of machinery and arms in the current year before it is to be furnished with 90,000 tons of Turkish chrome ore which is badly needed by the Reich. In the meantime, however, I. G. Farben and the Siemens electric concern are setting up sales offices and are sending German technicians to Turkey. The supplying of Turkish orders has been assigned to three large German firms: first, the Hermann Goering concern, subcontracting to its plants in Poland, Czechoslovakia, and Austria, which is to supply the basic steel; second, Krupp, which will furnish munitions from its Essen plant; and third, the Humboldt Deutsch concern, which is to furnish motors and army trucks.

G-771

HERSEY MANUFACTURING CO. No.

DRYING CALCULATION Ground Sweet Potatoes

DIRECT HEAT DRYER-WITHOUT RECIRCULATION-HOURLY BASIS

DATE

FOR [redacted]

SYSTEM-Intermediate Feed ☒ Concurrent Flow ☐ Countercurrent Flow ☐ Check which.

To facilitate later correction - Mark all quantities to which, because of lack of information, average values have to be given, with the letter A.

CONTROLLING VALUES

The fuel will be Coal ☐ Gas ☒ Oil ☐ and its net heating value, in B.T.U. per lb. - 21,163 -Q

Fuel weight; per cu. ft. if gas; ~~per gal. if oil~~ - lbs. - .043 -R

Combustion gases produced per lb. of fuel used - lbs. - 22 -S

Is any water of hydration to be driven off? Yes ☐ No ☒

Formula of dried material: Molecular wgt. -T

Formula of material as fed: Molecular wgt. -U

Heat of formation of U from T per lb. of U - B.T.U. - -V

Weight of U in feed - lbs. = BU÷T -W

Feed rate -lbs.- 3915

B-Output - - 2000

C-Evaporation - - 1915

Initial moisture content - % - 53

Final moisture content - - 8

D-Solids in output -lbs.- 1840

E-Water in output - - 160

Final temp. of material -°F.- 140

F-Initial temp. of material - - 70

G-Material temp. rise - - 70

H-Specific heat of solids - .35

J-Initial temp. of gases -°F.- 650

K-Final temp. of gases - - 150

L-Gas temperature drop - - 500

M-Sp. heat of H_2O vapor at (K+212)÷2 - --

N-Sp. heat of air at (J+70)÷2 - .243

P-Sp. heat of comb. gases at (J+70)÷2 - .268

HEAT REQUIRED - B.T.U.

To heat solids	DGH	45 080
To heat remaining water	EG	11 200
To heat evaporated water	C[(212 or K)-F]	153 200
For evaporation	C×Latent heat at 212° or K (1008)	1 930 320
To heat vapor	CM(K-212)	0
To drive off water of hydration	WV	0
Net total		2 139 800
33-1/3% of net for losses etc.		713 200
Total to be given up by gases in the dryer		2 853 000 -X

a-Heat lost in combustion gases, per lb. of fuel consumed - SP(K-70) - 473 B.T.U.

b-Heat available for drying, from combustion gases, per lb. of fuel consumed - SLP - 2948 B.T.U.

d-Heat available to heat additional air, per lb. of fuel consumed - Q-a-b - 17742 B.T.U.

e-Heat available for drying from additional air, per lb. of fuel consumed = dL÷(J-70) - 15293 B.T.U.

f-Fuel consumed = X÷(b+e) - 156.5 lbs. = f÷R or 3640 cubic feet, if gas - gallons, if oil.

g-Combustion gases produced per minute

h-Quantity of additional air required per min

k-Volume of combustion gases and air at K t

m-Volume of water vapor at K temperature

n-Total volume of gases handled by the fa

p-Density of the gases handled by the fan

Dryer - 5'x34', #10 Shell, Str

Fan - Size 50 Planovane F

Feeder - Size 5B Shaker with

Furnace - Gas Burning for 364

Dust Arrester - Size 20 long c

Remarks:- Air volume and By

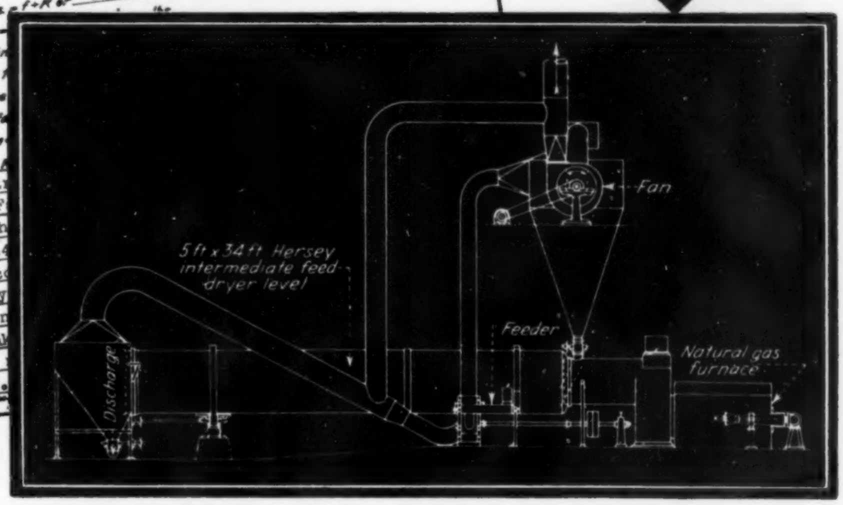
temperature and safety con

except to prevent air leak

Total HP required should

build it up considerably.

THIS IS WHY THIS HERSEY DRYER



DIRECT HEAT DRYER—WITHOUT RECIRCULATION—HOURLY BASIS

OPERATED AT FULL CAPACITY FROM THE START— A NEW SYSTEM PROCESSING A NEW PRODUCT

★ Hersey Engineers give all their attention to the calculation and design of Dryers. New equipment and new methods are constantly under study in our laboratory enabling us to bring a new viewpoint to each drying problem presented.

Whether your problem or your production is large or small, get in touch with Hersey.

HERSEY Hersey Manufacturing Company
Hersey Drying Machinery Division

E and SECOND STS.
SOUTH BOSTON, MASS.

NEWS OF PRODUCTS AND MATERIALS

BLACK-OUT PAINT

Black-out paint for use in darkening windows and skylights of industrial and commercial properties where it would be impractical to extinguish lights at the sound of an air-raid warning has been announced by American-Marietta Co., Chicago, Ill. The paint is being marketed in paste form, and when cut 50 percent with water can be sprayed or brushed on windows to prevent all passage of light. Coverage is 800 sq.ft. to the gallon. It dries within 40 minutes, providing a flat surface that will not flash back or glare when hit by artificial light used within the room. In interior applications, a single coat may be covered with a white paint where large glass surfaces make the higher reflection properties of a white surface necessary. Removal of the product, termed Valdura Black-Out, is made without damage to the glass. It is being packed in 1- and 5-gal. containers.

DECALCOMANIAS

A new process for making chinaware decalcomanias, which substitutes photo-lithography or hand-lithography in preparing plates from which decalcomanias are printed, has been developed by E. I. duPont de Nemours & Co., Wilmington, Del. Exact and yet more rapid reproduction of artists' designs are among advantages claimed for the process. In the new process artists' designs are photographed through color filters and reproduced on sensitized metal plates instead of being tediously stippled by skillful craftsmen on soft stone. The designs are then transferred by use of a special offset lithograph press. The artist's work is photographed through color filters for each color in the sketch. The camera detects and reproduces every detail and vestige of a particular color in the design, though it may not be visible to the naked eye. From each negative a positive is developed and from that positive is made a sensitized metal plate for the offset lithograph press. The plates incidentally may be re-used by etching off and regraining. The new process marks fully as important a change to the art of decalcomania as was the substitution of photo-engraving for woodcuts to the art of printing. With this new fidelity in reproduction, the artist now may go to any length in design, resting assured that his creation will be faithfully repeated in all its artistry. As a result it is predicted that chinaware more truly representative of American design and artistry will follow.

HIGH-IMPACT RESIN

High impact is the outstanding characteristic of Co-Ro-Lite, the trade name for a new material now being introduced by Columbian Rope Co. It opens new fields for plastics which have heretofore been closed for lack of this high-impact property. While uses for Co-Ro-Lite are still limited, continuing development is expected to broaden its scope. For such applications as gears, bearings, bobbin heads, abrasive disk hubs and backs, bumper parts, and other mechanical products, this new plastic is already being used. It is actually Durez-resin-impregnated sisal fibre. Attention is called particularly to the low density attainable with this plastic, yielding a product comparable in this effect to wood. The natural loftiness of the sisal and carefully planned resin distribution makes possible this unique effect. It is especially valuable where substitution for wood by a plastic composition of high toughness in all directions is desired, but where an increase in weight is inexpedient. An obvious use for this feature is in aircraft construction.

METAL DEACTIVATOR

A new metal deactivator designed to increase the storage stability of petroleum distillates has been developed by the Petroleum Chemicals Section of E. I. duPont de Nemours & Co., Inc. It is recommended for both gasoline and fuel oils containing soluble metallo-organic compounds or soluble metal salts of organic acids in which it will counteract the pro-oxidant or catalytic effect of those contaminants. The new product, a liquid, has the same functional properties as duPont Lube Oil Stabilizer S, a deactivator in powdered form. The acid constituent of the metal deactivator is revealed as N:N'-disalicylidine-1: 2-diaminopropane. This molecule forms stable complex compounds with various metals, such as copper, in which the ionization, as well as the catalytic activity of the metal atoms is greatly reduced. This renders them inactive in the oxidation process of the hydrocarbons.

N:N'-dialicylidene-1: 2-diaminopropane is a viscous liquid at ordinary atmospheric temperatures, and is therefore made suitable for general use by diluting four weight parts of it with one part of xylene.

Physical properties are characterized by the following typical analysis:

Specific gravity, 60 deg./60 deg. F	1.076
Pounds per gallon at 60 deg. F	8.96
Pour point	0 deg. F.
Viscosity at 100 deg. F	125 S.U.S.
Flash point (T.C.C.)	100 deg. F.
Fire point (C.O.C.)	135 deg. F.
Miscibility:	
Gasoline	In all proportions above 70 deg. F. 20% at 65 deg. F. 12% at 50 deg. F. 10% at 35 deg. F. Greater than 1.0% at −30 deg. F.
Fuel oil	—In all proportions above 30 deg. F. Greater than 1/2% at −30 deg. F.
Anhydrous benzene	—In all proportions above +40 deg. F.
Anhydrous acetone	—In all proportions above −30 deg. F.
Anhydrous methanol	—In all proportions above −30 deg. F.
Xylenols	In all proportions above −30 deg. F.
DuPont gasoline anti-oxidants	In all proportions above +35 deg. F.

SYNTHETIC PINE OIL

Synthetic pine oil is now made from gum turpentine by a new process, which makes it possible for the naval stores industry to meet current demands of the war program. This material is announced by Hercules Powder Co. The process developed by this company produces oil of substantially the same chemical and physical properties as natural pine oil. It may be described chemically as a well defined mixture of turpenes and secondary and tertiary alcohols having a mild aromatic pine aroma. Laboratory and plant tests indicate the new oil is suitable for all of the important uses for which pine oil is now employed. Included in these are textile wet finishing, paint and varnish manufacture, paper coating, essential oils, industrial and commercial laundering, disinfectants, liquid scrub soaps, industrial cleansers, cattle sprays, rag boiling, leather processing, flotation reagents in mining metals, metal polishes, liquid hand soaps, pine scented bar soaps and solvent for synthetic resins.

A typical analysis of the new pine oil is as follows:

Specific gravity at 15.6/15.6 deg. C.	0.9186
Refractive index at 20 deg. C.	1.4813
Unpolymerized residue	0.4
Specific rotation	—3.95 deg.
Freezing point	Below —10. deg. C.
Flash Point (Cleveland open cup)	154 deg. F.
Moisture	0.4
Color 500 amber series	3 amber
Color 200 red series	.25 red
Distillation Range 5%	198.0 deg. C.
Distillation Range 10%	199.0 deg. C.
Distillation Range 30%	203.0 deg. C.
Distillation Range 50%	208.2 deg. C.
Distillation Range 70%	214.2 deg. C.
Distillation Range 90%	219.5 deg. C.
Distillation Range 95%	223.0 deg. C.

PARA-CYMENE

Production of synthetic para-cymene (structurally para-methyl isopropyl benzene) from liquid terpenes is announced by Hercules Powder Co., Wilmington, Del. A new unit for the production of the material is nearing completion at the Brunswick, Ga., naval stores plant of the company.

Typical physical constants of the para-cymene developed by the company are:

% Para-cymene	not less than 95%
Boiling range (5–95%)	177.7° to 179.4° C.
Density $\frac{15.6°C.}{15.6°C.}$	0.8618
Optical rotation, n_D^{20}	1.4888
Color	water white
Unpolmerized residue	trace
Bromine number	3 to 7

An important use of para-cymene has been as an intermediate in the manufacture of phenols, carvacrol, thymol, and the cyclic alcohol, menthol. The essential oil industry consumes substantial quantities of carvacrol in the manufacture of odorants used in soaps.

TEXTILE CHEMICALS

An emulsion of a blend of synthetic resins used principally in the finishing of spun rayon and spun rayon mixed fabrics is known as Aerotex 301. It was developed by the American Cyanamid Co., New York. It can be applied by any of the usual methods used in the finishing of spun rayons; e.g., pad mangle and batch, quetch and batch, pad mangle and dry, quetch and dry, etc.

Aerotex 140 is a viscous synthetic resin emulsion for use in the backfilling and weighing of the lower count cotton fabrics. In combination with starches, dextrines, or gums it produces very satisfactory results in the back-sizing of carpets.

HAZE INHIBITOR

An ethyl gasoline haze inhibitor known as Aeroclear has been designed especially to prevent the formation of haze in gasoline containing tetraethyl lead. It is a development of the American Cyanamid Co., New York. Such gasoline, unless protected by a compound like Aeroclear, is particularly unstable in sunlight which causes the precipitation of an insoluble form of lead and makes the gasoline hazy or cloudy. In the measuring bowls or sight glasses of service stations gasoline pumps, this haze collects on the inner surface of the glass making it unsightly and frequently so cloudy as to lose transparency.

SYNTHETIC WAX

Domestic raw materials have been used for the production of the new synthetic wax, Stroba wax, by Glyco Products Co., Brooklyn, N. Y. It is a hard, light-colored wax with a melting range of 103–106 deg. C. It is soluble hot in most oils and hydrocarbon solvents. It forms gels in the cold with mineral spirits, mineral oil and toluol. Stroba wax is compatible with most waxes and resins. As a flatting agent for paints, varnishes and lacquers, the wax is of considerable interest, because of its compatibility with solvents. A stock gel can readily be made which can be added to the varnish as desirable in the cold, thus avoiding the lengthy and expensive grinding necessary with most flatting agents.

NYLON BRUSH

The first rug cleaning brushes bristled with nylon have been installed at Morey-LaRue Laundry, Elizabeth, N. J., and Elite Laundry Co., Washington, D. C. Nylon has been in continuous service on brushes in both concerns since last July. The former reports no sign of wear, whereas fiber brushes had to be rebristled at least three times a year. The latter company advises that vegetable fibers have a maximum life of six weeks, whereas nylon has shown little wear. A rug cleaning machine uses two rows of ten nylon bristled brushes, each above the main roller, which move simultaneously in opposite directions, assuring a thorough washing and scrubbing job.

A.I.M.E. and T.A.P.P.I. Conventions To Be Held in February

CHEM & MET NEWS OF MEETINGS & CONVENTIONS

COMPRESSED GAS MANUFACTURERS MEET IN NEW YORK

THE 29TH ANNUAL meeting of the Compressed Gas Manufacturers' Association, Inc., will be held January 26-27 at the Waldorf-Astoria in New York City. Some of the topics to be discussed in the technical sessions include: "War Uses of Oxygen and Acetylene"; "Incendiary Bombs and their Control," by Arthur B. Guise, Rockwood Sprinkler Co.; "Mobilizing Chemical Industry for War," by S. D. Kirkpatrick, editor of *Chem. & Met.*; and "Aviation Gasoline." There will be an open meeting for discussion of present problems of the industry.

A.I.M.E. TO HOLD 156TH ANNUAL MEETING IN NEW YORK

THE AMERICAN INSTITUTE of Mining and Metallurgical Engineers will hold its annual meeting in New York City, February 9-12. The technical sessions will be held in the Engineering Societies Building. The All-Institute luncheon on Monday will be at the Commodore Hotel; the annual banquet and president's reception will be at the Waldorf-Astoria Hotel. The dinners of the Petroleum Division and the Institute of Metals Division will be at the Roosevelt Hotel. The All-Institute luncheon will feature a speaker from Washington who is playing one of the most prominent parts in the war program. This message will be of vital importance.

A session under the auspices of the committee on Industrial Preparedness, Wilfred Sykes, chairman, will be held Tuesday afternoon. It is planned to have an inventory of the available supplies of metals and minerals in 1942 and, where possible, an estimate of civilian requirements for the same year. At the annual banquet, to be held on Wednesday, the James Douglas medal will be presented to Arthur S. Dwight; the Robert W. Hunt prize to Harold K. Work; and the J. E. Johnson, Jr. award, to L. F. Sattele.

Technical papers at the sessions will be concentrated on war demands and shortages of metals and minerals. A few of the subjects to be discussed include: aviation gasoline, world consumption of petroleum products and related fuels, phosphate deposits of the world, progress in special methods of concentrating industrial minerals, flotation concentration of alunite, utilization of Wyoming trona, magnesite deposits in Washington and Nevada, the Bureau of Mines pilot plant for the beneficiation of domestic manganese ores, lead in national defense, a new electrolytic zinc plant, review of the tungsten industry, laws of crushing, a new method of mining phosphate rock, and mining and processing of vermiculite. Many other technical papers will also be presented.

A.C.S. HOLDS SYMPOSIUM ON INDUSTRIAL AND ENGINEERING CHEMISTRY

THE EIGHTH ANNUAL symposium of the Division of Industrial and Engineering Chemistry of the American Chemical Society was held December 29-30 at the Case School of Applied Science in Cleveland.

Utilization of thermodynamics in war-time chemical industries was the theme of the symposium, of which Professor C. C. Furnas of Yale University was chairman. An address on "Metals vs. Plastics" by Dr. A. A. Bates, director of chemical research, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., featured the two-day meeting. Among the other speakers were Dr. J. G. Aspon of Pennsylvania State College; Dr. G. G. Brown of the University of Michigan; Dr. George Glockler of the University of Iowa; Dr. H. R. Wilson of the National Carbon Co.; Dr. H. C. Carlson of the du-Pont Company; Richard Wiebe of the Northern Regional Research Laboratories, Peoria, Ill.; Dr. E. R. Gilliland, of Massachusetts Institute of Technology.

SYMPOSIUM ON PHYSICAL AND INORGANIC CHEMISTRY HELD IN COLUMBUS

THE SIXTH ANNUAL symposium of the Division of Physical and Inorganic Chemistry of the American Chemical Society was held in the Hotel Fort Hayes, Columbus, Ohio, December 29-31. Devoted to "recent developments of non-metals", the symposium included reports on a practical process for the manufacture of sulphamic acid, an advanced study of the structures of complex fluorides, the importance of new tool metals to national economy and latest progress in the analysis of boron.

A new method of producing chlorine and salt cake from salt and sulphur was described by A. W. Hixson and A. H. Tenney of Columbia University. Other papers were presented by Dr. E. P. Partridge of the Hall Laboratories, Inc.; Dr. C. R. McCrosky of Syracuse University; Drs. M. E. Cupery and W. E. Gordon of E. I. du-Pont de Nemours & Co.; and Philip McKenna of McKenna Metals Company, Latrobe, Pa.

A.S.M.E. ELECTS OFFICERS

CONVENING IN NEW YORK December 1-5 for its 62nd annual meeting, the American Society of Mechanical Engineers elected James W. Parker, vice president in charge of engineering of the Detroit Edison Co., as the new president for the coming year. Mr. Parker called upon the society's more than 16,000 members to lend their full support to the twin objectives of war-goods production and the solution of post-war problems.

CALENDAR

JAN. 26-30,	**American Society of Heating and Ventilating Engineers, annual meeting, Commercial Museum, Philadelphia, Pa.**
FEB. 9-12,	**American Institute of Mining & Metallurgical Engineers, annual meeting, Engineers Building, New York, N. Y.**
FEB. 16-19,	**Technical Association of the Pulp & Paper Industry, annual meeting, Commodore Hotel, New York, N. Y.**
MAR. 2-5,	**American Society for Testing Materials, committee week and spring meeting, Cleveland, Ohio.**
MAR. 23-25,	**American Society of Mechanical Engineers, spring meeting, Houston, Texas.**

Four newly elected vice presidents also took office as members of the Council. They were: Clarke F. Freeman, of Providence, R. I., senior vice president and engineer of the Manufacturers Mutual Fire Insurance Company; Clair B. Peck, manager-editor of Railway Mechanical Engineering; W. H. Winterrowd, vice president in charge of operations, Baldwin Locomotive Works, Eddystone, Pa.; and W. R. Woolrich, University of Texas.

SELECTIONS FROM CONVENTION PAPERS

INCREASING USE OF RECLAIMED RUBBER

DOMESTIC PRODUCTION of reclaimed rubber in 1940 amounted to 210,000 long tons. Operating at near capacity, the industry is now reclaiming rubber at the annual rate of more than 270,000 long tons, according to the U. S. Tariff Commission in a recent study. Leaders of the industry state that they could increase production 20 percent by reducing the varieties from the present 100 or more to 3 or 4 and by not carrying the refining so far as is now the practice. These methods would permit production of about 340,000 long tons a year.

Capacity of the reclaimed rubber industry could be increased by erecting additional plants. Estimates as to the quantity of scrap that could be collected annually range from 400,000-800,000 long tons. Available data indicate that at least 500,000 tons could be collected to produce about an equal tonnage of reclaimed rubber.

Cost of additional reclaiming facilities would be about \$10,000,000 per 100,000 tons of yearly capacity. With the benefit of priorities for necessary materials and equipment, it would require 18-24 months to construct and equip a sufficient number of plants to produce 100,000 tons yearly.

Except for certain types of goods, reclaimed rubber is not as satisfactory as natural Hevea rubber as it is comparatively soft and lacks the "nerve" of Hevea. In the manufacture of tires it can be mixed with Hevea and used satisfactorily in rubberizing fabric plies and in sidewalls, but it lacks the resistance to abrasion required for extensive use in treads.

Ordinarily, a 6:00×16 tire weighing 21 lb. will contain about 12 lb. of Hevea rubber. By partial substitution with reclaim, a fairly good tire of this size could be made with 5½ lb. of Hevea rubber distributed as follows: 3½ lb. in tread, 1 lb. in sidewalls and undertread and 1 lb. in fabric plies. This tire is said to give a mileage about 75 percent that of a tire containing 12 lb. of natural rubber.

Cost of producing reclaimed rubber is relatively small. This is seen from the fact that reclaimed rubber for use in tires has been sold at 6 to 7¾ cents per lb. for the past 2-3 years.

• • •

A program has recently been worked out to give the nation an annual production of 120,000 tons of synthetic rubber. Productive facilities now under construction will have a capacity of 40,000 tons per year.

DYESTUFFS SHORTAGE

DYESTUFFS IN NATIONAL DEFENSE were discussed by H. F. Herrmann, General Dyestuffs Corp., before the American Association of Textile Technologists in New York.

Aniline—Aniline finds its way into diphenylamine as a gunpowder stabilizer and hence the government is taking the bulk of production. It is also the most important accelerator for rubber and thus is highly important for defense purposes. With 80–85 percent of aniline production diverted to defense requirements, the dyestuffs manufacturer is encountering difficulty in continuing his line of colors. About 250 actively used dyestuffs are directly or secondarily dependent on aniline.

Phthalic Anhydride—Phthalic anhydride is of utmost importance as a component of plastics for airplanes and other applications. To the dye manufacturer it represents the starting material for anthraquinone, the basic element of the best vat, alizarine-chrome and acid dyes, and the very important phthallocyanine blues and greens. The government needs these dyes above all others for production of cotton and woolen uniforms and camouflage paints.

Blueing Pigments—To offset the yellowness of imperfectly bleached pulps, paper manufacturers have been endeavoring to use larger quantities of blueing pigments, the most important of which are the phosphotungstic lakes of certain basic blues and violets. However, tungsten is used in the production of steel alloys, as a consequence of which the amount of tungsten permitted for dyestuff use has been reduced appreciably. The best papers will soon be marketed appreciably yellower or tinted with fugitive dyes.

• • •

A finely wet-ground white mica is said to have both activating and accelerating properties in most types of rubbers. Thus the ZnO content may be reduced to 1–1.5 percent.

• • •

DOMESTIC SOURCES OF MANGANESE

OUTLOOK FOR supplying domestic requirements of manganese appear favorable without going outside the Western Hemisphere, reported Frederick Laist, Anaconda Copper Mining Co., Butte, Mont., before the American Mining Congress in San Francisco. The problems, reported the author, are chiefly metallurgical.

Long rail hauls have hampered western manganese producers since fur-

naces for smelting the ore to ferro-manganese are in Pennsylvania and Virginia. The author advocated establishing ferro-manganese furnaces in the Chicago area.

The Philipsburg district in Montana contains the only substantial supply of ferro-grade concentrates in the United States. About 40 percent of domestic requirements can be obtained from Cuba, Montana, and from other localities in the United States from ores that can be concentrated mechanically. Another 20 percent can be obtained from South America, leaving about 40 percent to be supplied from other sources.

In order to obtain this 40 percent, it is necessary to resort to ores which cannot be milled, which are low-grade and which have never been treated or considered as a source of supply under normal conditions. Such ores occur in large tonnages in the vicinity of Artillery Peaks, Ariz., near Chamberlain, S. Dak., and in the Cuyuna Range, Minn. They average about 5-15 percent Mn and must be treated by hydrometallurgical methods or by smelting. Cost of plants and treatment will be high and it is questionable whether any of these operations can survive the emergency. If successful methods of treatment can be devised, as seems probable, the manganese needed to make up the deficiency can be obtained from such ores.

The Artillery Peaks deposits contain probably 10 million tons of ore of 10 percent or about 50 million tons of 5 percent Mn. The ore would have to be mined by underground methods and treated by leaching.

Largest known domestic deposit of manganese occurs in Chamberlain, S. Dak. in carbonate nodules that average 16 percent Mn and constitute about 6 percent of the shale. The shale, therefore, averages only about one percent Mn even though the quantity of Mn has been estimated as high as 800 million tons. The greater part of the shale bed is covered by 150 ft. of gangue and could not be mined at a reasonable cost considering its low grade. There are, however, about 50,000 acres which are free from over-burden and could be mined by electric shovels. This area is said to contain about 50 million tons of nodules or 8 million tons of Mn.

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Soda ash, instead of manganese, may soon be used in this country for desulphurizing steel. The English have been using soda ash for this purpose for some time.

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ALUMINUM ALLOY RESISTANCE SPOT WELDING

ALUMINUM ALLOY SPOT WELDING provides the engineer with a new and valuable tool, reported P. H. Merriam, Glenn L. Martin Co., before the American Welding Society. Spot welds are exceptionally strong and inexpensive to make, and their smooth surface eliminates flush tight rivets or screws.

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DYESTUFFS SHORTAGE

Dyestuffs in national defense were discussed by H. F. Herrmann, General Dyestuffs Corp., before the American Association of Textile Technologists in New York.

Aniline—Aniline finds its way into diphenylamine as a gunpowder stabilizer and hence the government is taking the bulk of production. It is also the most important accelerator for rubber and thus is highly important for defense purposes. With 80–85 percent of aniline production diverted to defense requirements, the dyestuffs manufacturer is encountering difficulty in continuing his line of colors. About 250 actively used dyestuffs are directly or secondarily dependent on aniline.

Phthalic Anhydride—Phthalic anhydride is of utmost importance as a component of plastics for airplanes and other applications. To the dye manufacturer it represents the starting material for anthraquinone, the basic element of the best vat, alizarine-chrome and acid dyes, and the very important phthallocyanine blues and greens. The government needs these dyes above all others for production of cotton and woolen uniforms and camouflage paints.

Blueing Pigments—To offset the yellowness of imperfectly bleached pulps, paper manufacturers have been endeavoring to use larger quantities of blueing pigments, the most important of which are the phosphotungstic lakes of certain basic blues and violets. However, tungsten is used in the production of steel alloys, as a consequence of which the amount of tungsten permitted for dyestuff use has been reduced appreciably. The best papers will soon be marketed appreciably yellower or tinted with fugitive dyes.

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A finely wet-ground white mica is said to have both activating and accelerating properties in most types of rubbers. Thus the ZnO content may be reduced to 1–1.5 percent.

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DOMESTIC SOURCES OF MANGANESE

Outlook for supplying domestic requirements of manganese appear favorable without going outside the Western Hemisphere, reported Frederick Laist, Anaconda Copper Mining Co., Butte, Mont., before the American Mining Congress in San Francisco. The problems, reported the author, are chiefly metallurgical.

Long rail hauls have hampered western manganese producers since fur-

naces for smelting the ore to ferro-manganese are in Pennsylvania and Virginia. The author advocated establishing ferro-manganese furnaces in the Chicago area.

The Philipsburg district in Montana contains the only substantial supply of ferro-grade concentrates in the United States. About 40 percent of domestic requirements can be obtained from Cuba, Montana, and from other localities in the United States from ores that can be concentrated mechanically. Another 20 percent can be obtained from South America, leaving about 40 percent to be supplied from other sources.

In order to obtain this 40 percent, it is necessary to resort to ores which cannot be milled, which are low-grade and which have never been treated or considered as a source of supply under normal conditions. Such ores occur in large tonnages in the vicinity of Artillery Peaks, Ariz., near Chamberlain, S. Dak., and in the Cuyuna Range, Minn. They average about 5-15 percent Mn and must be treated by hydrometallurgical methods or by smelting. Cost of plants and treatment will be high and it is questionable whether any of these operations can survive the emergency. If successful methods of treatment can be devised, as seems probable, the manganese needed to make up the deficiency can be obtained from such ores.

The Artillery Peaks deposits contain probably 10 million tons of ore of 10 percent or about 50 million tons of 5 percent Mn. The ore would have to be mined by underground methods and treated by leaching.

Largest known domestic deposit of manganese occurs in Chamberlain, S. Dak. in carbonate nodules that average 16 percent Mn and constitute about 6 percent of the shale. The shale, therefore, averages only about one percent Mn even though the quantity of Mn has been estimated as high as 800 million tons. The greater part of the shale bed is covered by 150 ft. of gangue and could not be mined at a reasonable cost considering its low grade. There are, however, about 50,000 acres which are free from over-burden and could be mined by electric shovels. This area is said to contain about 50 million tons of nodules or 8 million tons of Mn.

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Soda ash, instead of manganese, may soon be used in this country for desulphurizing steel. The English have been using soda ash for this purpose for some time.

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ALUMINUM ALLOY RESISTANCE SPOT WELDING

ALUMINUM ALLOY SPOT WELDING provides the engineer with a new and valuable tool, reported P. H. Merriam, Glenn L. Martin Co., before the American Welding Society. Spot welds are exceptionally strong and inexpensive to make, and their smooth surface eliminates flush tight rivets or screws.

Electric resistance spot welding, as applied to steel, has been in use for several decades. Due to the critical metallurgical properties of the aluminum alloys, however, particularly their narrow plastic range and high electrical conductivity, the methods applicable to steel were inadequate when applied to the lighter alloys.

Development of the mercury vapor contactor, called the ignitron tube, is largely responsible for the rapid development of the process. This device makes it possible to control extremely heavy currents with ease and accuracy. Inspired by this development, welding equipment manufacturers developed high capacity welding transformers capable of delivering the current necessary for aluminum alloys and precision-made welding machines capable of applying the welding pressure accurately and consistently.

For a representative aluminum alloy used in aircraft construction, 25,000 amp. are required and this current flows for only one-tenth of a second. Only the smallest variations are allowable in order to produce welds of acceptable physical and metallurgical qualities. For example, a difference of 500 amp. or of 1/100th of a second may seriously affect the quality of the weld. Due to the almost limitless possibilities of this method, continuous development work is being pursued to increase production speed, reduce costs and extend applications.

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The 16-2 type of stainless steel used in England is satisfactory for all normal uses of the standard 18-8 stainless and results in savings of nickel. The annealed 16-2 has a tensile strength of 135,000 lb. per sq.in., elongation of 17.5 percent, and Brinell hardness of 248. When hardened and tempered it has a tensile strength of 180,000 lb. per sq.in., elongation of 15 percent and hardness of 364. Corrosion resistance is nearly as high as for the 18-8 type now widely used.

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COST OF ABSENTEEISM TO INDUSTRY

According to Andrew Fletcher, St. Joseph Lead Co., New York, before the Industrial Hygiene Foundation in Pittsburgh, only six percent of all absenteeism in that concern resulted from accidents while at work. Influenza, grippe, and colds alone accounted for somewhat over 25 percent of the total shifts lost by absenteeism in this concern's Southeast Missouri operations.

In 1923, this concern spent about ten cents per $100 of payroll for safety work and cost of accidents was $3.51 per $100 of payroll; in 1940 the company spent 93 cents for safety and cost of accidents was 97 cents per $100 of payroll. Since the indirect cost of accidents has been estimated to be about three times the direct costs, this would be about $3.00 and the total cost about $4.00 per $100 of payroll.

Since this company has found that approximately two percent of the total shifts worked have been lost through absenteeism, it has assumed that in its operations two percent extra men are being carried to compensate for this loss. With a force of 5,000 men, there are possibly 100 extra men whose annual earnings would approximate $180,000. This figure may be considered as the "direct" loss to the company through absenteeism. Using the indirect cost of three times the direct, then the "indirect" cost of absenteeism would approximate $540,000, thus making a total annual loss of $720,000. However, there will always be some sickness and miscellaneous absenteeism, possibly 50 percent. Therefore, the amount that can be reasonably saved would be $360,000, or about $70 per employee in a force of 5,000. *If, therefore, you wish to approximate the cost of absenteeism in your own plant, multiply the number of workers by $70 per year.*

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Aluminum paint containing up to 75 percent of 325-mesh mica is claimed to have better resistance to salt air and chemical fumes than the regular aluminum paint product.

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ALUMINA FROM ALUNITE

AN INTERESTING DISCUSSION of the Kalunite process for obtaining alumina was given before the American Mining Congress in San Francisco by Frank Eichelberger, president of Kalunite, Inc. and abstracted in the October issue of *Mining World*. Alunite is a hydrated basic potassium aluminum sulphate with the formula $K_2SO_4 . 3Al_2O_3 . 3SO_3 . 6H_2O$. It occurs in large amounts, particularly near Marysvale, Utah. The grade varies from 15-20 up to 35 percent Al_2O_3.

Previous efforts to treat this ore isolated potash alum but efforts to convert this to pure Al_2O_3 failed. At this point the Kalunite process provided the technology on which to utilize low-grade ores such as alunite and clay. Conversion of potash alum to a basic compound by autoclaving, the novel step introduced by the Kalunite process, is as fundamental as Bayer's method for utilizing bauxite ores, reported the author. Any ore which can be converted to potash alum can be treated by the Kalunite process.

The Kalunite process for production of Al_2O_3, K_2SO_4 and H_2SO_4 from alunite can be divided into the following steps: (1) manufacture of potash alum; (2) autoclaving the potash alum to a hydrous basic potassium aluminum sulphate; (3) calcination of this to drive off sulphur oxides from the alumina; and (4) leaching of soluble K_2SO_4 from insoluble alumina.

In step one, alunite, after grinding to -16 or 20 mesh, is dehydrated in a multiple hearth furnace at slightly under 600 deg. C. below which no loss of SO_3 occurs. The dehydrated product is then put through a counter-current

leaching circuit with cyclic H_2SO_4 and K_2SO_4 solutions derived from the autoclaving step. As this operation is continuous, pulp from the first agitator contains an excess of calcined alunite so that no free H_2SO_4 is present and the solution is slightly basic with free Al_2O_3. Silica, titania, and most of the iron impurities are not soluble in the dilute solution. Pulp from the first agitator is run to a thickener and the overflow is either filtered or cooled and the alum crystallized. This leaching process converts dehydrated alunite to potash alum crystals. The function of these steps is to purify the alumina.

Step two consists in autoclaving the potash alum. When the washed alum crystals come off the filter, they are dissolved in dilute K_2SO_4 liquor obtained from the last step in the process. A strong alum solution is made and this is pumped through a continuous autoclave at 250 lb. per sq.in. and steam is introduced at about 250 deg. C. Excess steam is used in the leaching and dissolving steps. This autoclaving step forms basic potassium aluminum sulphate with the liberation of H_2SO_4, K_2SO_4 and water, according to the equation: $3\ K_2SO_4 . 3\ Al_2O_3 . 9\ SO_3 . 72\ H_2O = K_2SO_4 . 3\ Al_2O_3 . 4\ SO_3 . 9\ H_2O + 5\ H_2SO_4 + 2\ K_2SO_4 + 58\ H_2O$. The basic alum formed is insoluble in water or dilute H_2SO_4 and settles rapidly in a thickener. The hot clear $K_2SO_4 - H_2SO_4$ overflow from the thickener is returned to the leaching circuit. Autoclaving dehydrates the normal alum and reduces its bulk by the elimination of $\frac{2}{3}$ of the K_2SO_4, $\frac{5}{6}$ of the H_2SO_4, and $\frac{7}{8}$ of the water.

Step three consists of calcining the product from the autoclave to drive off sulphur oxides from alumina, after which the basic alum is pumped from the thickener, filtered and fed to the top hearth of a 10-hearth furnace. The top four hearths are open, the lower six are muffled. The upper two hearths are used as dryers and in the next two the nine mols of water of combination are driven off. In the six muffled hearths the heat is gradually raised to about 100 deg. C. Above 600 deg. C., SO_3 begins to evolve from the aluminum sulphate. The K_2SO_4 does not fuse at temperatures reached in the furnace and the end product is a mechanical mixture of Al_2O_3 and K_2SO_4 according to the equation: $K_2SO_4 . 3\ Al_2O_3 . 4\ SO_3 = 3\ Al_2O_3 + K_2SO_4 + 2\ SO_3 + 2\ SO_2 + O_2$. As there is an excess of sulphur in alunite over what is used in the process, only the SO_3 is recovered. If there is a market for H_2SO_4, the SO_2 can be recovered as acid.

In step four the hot calcine from the furnace is introduced into a countercurrent leaching circuit, where the K_2SO_4 is leached out with water, the solution filtered, and the Al_2O_3 filter cake dried, ready for reduction to metal. The K_2SO_4 is recovered by crystallization. As nearly all alunites contain Na_2O, some soda alum is formed. In cold solutions containing 50–60 percent potash alum, some soda alum crystallizes and finally shows up as Na_2SO_4 in the K_2SO_4. As the hot calcine

is dumped into the leaching circuit a great deal of water is boiled off and it is here that make-up water is added.

Commercial production of aluminum from alunite will begin in 1942 with an estimated daily capacity of 50 tons of aluminum ingot. The author stated that the future of this process in the production of Al_2O_3 for aluminum is purely one of competitive costs.

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Bentonite can be substituted to a large extent for alum in treatment of water, the most favorable ratio being 1.4 times as much alum as bentonite. The bentonite eliminates the necessity for controlling the pH for good coagulation, and flocs settle more rapidly than those from alum alone.

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DEVELOPMENT OF NYLON

Nylon yarns are now being produced at Seaford, Del. at a rate sufficient to supply about 20 percent of the full-fashioned hosiery market. Another plant at Martinsville, Va., which began operations the first of November, is expected to double this output by the summer of 1942. Plans are now under consideration for a further increase, although the present critical situation of phenol may alter such plans.

Information on the research program which led to the industrialization of nylon was given by E. K. Bolton of E. I. duPont de Nemours & Co., on the occasion of his receipt in New York of the Chemical Industry Medal of the American Section of the Society of Chemical Industry.

Research activities preceding the manufacture of nylon yarn were divided into three periods: (1) fundamental research activities; (2) concentration on polyamides, which led to the synthesis of a polymer having properties suitable for use as a fiber; and (3) development of practical processes for manufacture of intermediates and polymer and for the spinning of fibers.

The second period was characterized by a concentrated effort to synthesize a polyamide which might form the basis for a commercial fiber. Polyamides were prepared from a variety of amino acids, dibasic acids and diamines. Early in 1935, polyhexamethylene adipamide was synthesized from hexamethylenediamine and adipic acid. From this polyamide, fibers were formed which, following cold-drawing, possessed high tensile strength, elasticity and melting point, which were insoluble in dry cleaning solvents, and which would not support mold and mildew nor be attacked by moths.

From the inception of laboratory work until designs were turned over to the construction engineers, about 230 chemists and engineers were at one time or another engaged in this development. However, less than five years elapsed between the invention of synthetic super-polyamides and completion of a large-scale plant.

The third period covered development on a laboratory scale of manufacturing processes for intermediates, for the polymer and nylon yarn; and development on a semi-works scale of chemical and engineering data for the erection and operation of a large-scale plant. This phase of the development represented one of the largest cooperative projects within the experience of the company. Many highly complex problems not hitherto encountered in chemical engineering practice had to be solved.

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Epsom salts are now being made by one operator near Sylva, N. C. by acid digestion of olivine, a magnesium-iron silicate abundant in that state.

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ECONOMICS OF SYNTHETIC RUBBER PRODUCTION

AVAILABILITY AND potential supply of raw materials for synthetic rubber and their economics were discussed before the American Chemical Society in Atlantic City by H. I. Cramer, Sharples Chemicals, Inc., Philadelphia. The basic raw material which will be required in the greatest tonnage is butadiene. Petroleum byproduct butane or the butenes constitute our main supply of this raw material. It has been estimated that the petroleum industry can supply raw material to produce butadiene and styrene at the rate of 85 billion lb. a year without lessening production of other peacetime or national defense needs.

By comparison, the estimated figure of 1,650,000,000 lb. for consumption of crude rubber in the United States in 1941 is dwarfed. Butane is now selling for 3 cents per gal. or 0.6 cents per lb. It may be concluded, therefore, that we are in a fortunate position in this country with respect to the supply of cheap raw materials.

As a result of relatively small-scale production, butadiene is now being produced to sell in the range of 20–25 cents; styrene at 30–35 cents and acrylonitrile at 35 cents per lb. The cost of the various buna types derived from these monomers at this time is due to the relative low tonnages being produced. It has been estimated that on a large tonnage basis, butadiene could be produced for 10–15 cents and the finished polymers for 20–25 cents per lb. The price of crude natural rubber is now approximately 23 cents per lb. The various synthetic products, to be competitive with natural rubber at its present price on a volume basis would have to sell at the prices indicated in the following table:

Product	Aug. 1941 Price	Density	Equivalent Price
Natural rubber	$0.23	0.92	0.23
Neoprene GN	0.65	1.24	0.17
Buna S	0.60	0.96	0.22
Purbunan	0.70	0.96	0.22
Thiokol F	0.45	1.38	0.15
Vistanex	0.45	0.90	0.24
Koroseal (30% plasticizer)	0.60 (est.)	1.33	0.16
Hycar OR	0.70	1.00	0.23

Present and projected tonnage production of synthetic rubbers were summarized in the table below:

Product	July 1941	Jan. 1942
Buna types	5,000	10,750
Neoprene	6,500	9,000
Thiokol	1,750	1,750
Polyvinyl Chloride*	5,000	6,000
Total	18,250	27,500
Percent normal requirements	3	4.6

* Includes plasticizer, 40 percent.

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Tetraethyl lead, according to one estimate, now consumes 60,000 tons of lead annually, and this is expected to increase to 65,000 tons or more during 1942. Under recent operations, producing 150,000,000 lb. of tetraethyl lead a year, it has been reported that the industry is producing 30 tons of chlorine a day more than it consumes. Some 50 percent of the tetraethyl lead has previously been going into defense products and uses.

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CURRENT SUPPLIES OF ALUMINUM AND COPPER

NON-DEFENSE USERS of metals cannot look for relief from the increasing shortages of these materials "for a long time to come," according to R. E. McConnell of the Engineers Defense Board before the American Institute of Chemical Engineers at Virginia Beach. Of the metals most important in defense, there are two which are not now produced or imported in sufficient quantities to supply military needs: aluminum and magnesium.

Simultaneous construction of some 20 airplane plants throughout the country has accelerated the rate of consumption of aluminum faster than bauxite mines could be developed, aluminum plants constructed and power made available. The time between the announcement of a long-range bomber program and completion of the several airplane plants to make the additional bombers is much less than the time required to build additional aluminum capacity.

Present production of aluminum is at the rate of 600 million lb. per year, double the rate for 1939. In the next 12 months domestic production will reach 900 million lb. per year and provisions have been made for 200 million lb. from Canada. In 18 months capacity will reach about 1,500 million lb. per year.

An acute shortage of copper has developed in the last six months and the prospects are that conditions will become worse. Recent estimates of copper tonnage for defense requirements indicate that the total productive capacity of the entire Western Hemisphere south of Canada may be necessary to supply only military requirements.

Current domestic production of copper plus imports is about 1,600,000 tons per year, an all-time peak. Defense requirements are more than 1,300,000 tons annually. This leaves 300,000 tons for non-defense needs,

which is less than 20 percent of the present demand. The situation is very serious, because for many uses copper has no substitute. The shortage of copper will cause more inconvenience and dislocations than any other single shortage.

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A new product, consisting of 70 percent barium sulphate and 30 percent calcium carbonate, precipitated simultaneously, can be used to save blanc fixe. The new product is recommended as a diluent or extender and for reduction of high-strength oxides of titanium, zinc and antimony.

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MATERIALS FOR PROTECTIVE COATINGS INDUSTRY

STATUS OF CHEMICALS used in protective coatings was given before the annual meeting of the National Paint, Varnish and Lacquer Association in Chicago by J. B. Davis, Chief of the Protective Coatings Section of OPM.

Oils—Use of tung oil and perilla oil is definitely reduced but the use of oiticica and dehydrated castor oil is being increased. Use of fish and soybean oils will likely diminish as these are needed for vitamins and edible oils. Linseed oil has shown a rapid increase, amounting to 32 percent in the first quarter and 34 percent in the second quarter of 1941 over 1940. Consumption of linseed oil for the first six months of 1941 was equivalent to 20,401,700 bu. of flaxseed and it is estimated that consumption during 1941 will represent 45–50 million bu. Of the 1941 crop of flax, 20–21 million bu. will probably be available for oil. Therefore, the protective coating industries will need to import some 25–30 million bu. from South America. Shipping, handling facilities, and storage space offer difficulties to this program.

Naphthalene—Phthalic anhydride is derived from naphthalene which is in turn tied up with coking operations. Coking is now done on a basis which reduces the yield of tar oils and naphthalene, thus affecting not only phthalic anhydride, but also phenol and cresol. The British have found that in many of their coking plants it did not pay to recover the tar oils and it was considered the lesser of two evils to do with less byproduct coke materials and return to higher coking temperatures. Production of naphthalene is being increased about 15 percent and phthalic anhydride will probably amount to 80 million lb. in 1941. Early in 1942 production will be up to perhaps 105 million, possible 115 million lb. Recent figures show that about 75 percent of the total production of phthalic anhydride goes into resins and plasticizers.

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A mixture of heavy mineral oil and coconut oil has been successfully used as a substitute for olive oil in wool processing.

OXALIC ACID FROM SAWDUST

Strategic importance of oxalic acid is shown by development of a military use which will probably double the normal demand. In connection with the new importance of this material, a process for making oxalic acid from sawdust was reported before the American Chemical Society in Atlantic City by D. F. Othmer, C. H. Gamer, J. J. Jacobs, A. H. Pabst and R. H. Royer, all of the Polytechnic Institute of Brooklyn.

Fusion of NaOH with sawdust to produce salts of oxalic and acetic acids is not a new process, having for years been the commercial source of oxalic acid. The authors studied the fusion operation from the standpoint of more efficient recovery of by-products and increase of yield by control of process variables. Optimum values of certain variables were:

(1) Ratio of NaOH to sawdust. 3:1
(2) Concentration of NaOH... 50%
(3) Time of fusion........... 3 hr.
(4) Temperature of fusion..... 220° C.

Fusing in thin layers or blowing air over the mass increased the yield of oxalic acid. Since NaOH is the most expensive raw material, its efficient recovery is a requisite of the successful operation of the process. Recycle runs showed the necessity for a 14 percent make-up of NaOH, but a materials balance indicated that this could be reduced to three percent.

Continuous fusion apparatus consisted of a steel trough 20 ft. × 7 in. × 8 in. deep. Forward motion was obtained by the use of 40 vanes bolted at an angle to form a continuous helix, to a 2-in. drive shaft. The shaft was driven by a 2-hp. motor through a worm-gear speed reducer and chain sprocket drive, set to turn the shaft at approximately 6 r.p.m.

The fusion mass was a mixture of NaOH, Na_2CO_3, and sodium oxalate, formate, acetate, and humus. A method of separating the salt was to leach the mass with water, evaporate to 38 deg. Be., and precipitate out most of the sodium oxalate, acetate, and formate. After centrifuging, the liquor (containing the free NaOH and some sodium acetate) could be evaporated and recycled. The filter cake was treated with milk of lime to precipitate out calcium salts of the acids. The regenerated NaOH was evaporated and recycled.

Caustic fusion produces volatile constituents such as methanol, and noncondensable gases such as CO_2, CO, N_2 and O_2. Fractional crystallization and precipitation, following evaporation to the correct concentration were used to give preliminary separation of the oxalate, of the acetate and formate together, and of the carbonate and caustic.

Approximately 100 lb. of dry sawdust will produce 50 lb. of oxalic acid, 14 lb. of acetic acid, and 4 lb. each of formic acid and wood alcohol. In normal times these products have a total selling price of $7.94.

SELECTIONS FROM FOREIGN LITERATURE

RECOMPRESSION OF STEAM

Four types of recompression have been observed in steam nozzles. In *equilibrium recompression* the kinetic and heat energies are in equilibrium and the lowest pressure in the nozzle is reached for fixed inlet and outlet pressures. *Latent recompression,* following supercooling or supersaturation, depends on change of state of water drops and on latent heat of vaporization. *Vena contracta recompression* occurs as steam recovers from an abrupt change in area at the throat or excessive narrowness in the converging portion of the nozzle. *Shock recompression* follows sudden overexpansion caused by a disturbance of flow.

The Venturi effect has been observed in single nozzles and in both parts of a composite nozzle. Steam behavior in equilibrium recompression in convergent-divergent nozzles can be calculated from the equation:

$$p_r = 8.05 p_1 / (p_1 - p_0)$$

where p_r is recompression pressure, p_1 is inlet pressure and p_0 is outlet pressure. Vena contracta recompression can be controlled by suitable nozzle design. Studies of the influence of nozzle shape on recompression losses indicate the need for redesigning the nozzles now commonly used to give shorter length and larger inlet radius at the throat. Surface roughness as a cause can be eliminated by using polished brass instead of cast iron nozzles.

Digest from "Recompression Phenomena in Steam Nozzles," by C. A. Robb, *Canadian Journal of Research* **19A**, 67–85, 87–101, 1941. (Published in Canada.)

CRYSTALLIZATION IN SLAGS AND GLASSES

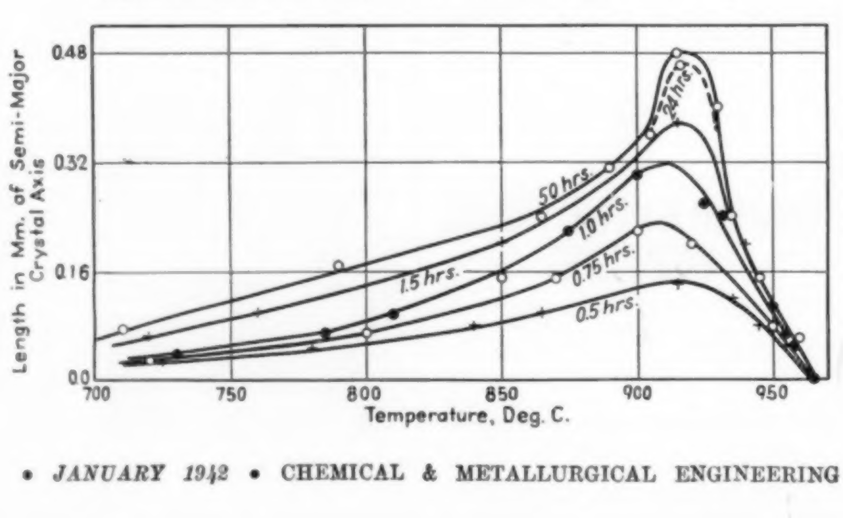
Unlike the crystallization behavior of molten mixed metals during eutectic separation, silicate slags and glasses retain the individual crystalline characteristics of each phase within the binary eutectic range of the system. Fused silicates such as commercial glasses and slags are ideal for study of crystallization processes in supercooled systems. Experiments have clearly demonstrated that eutectic separation in such systems is the simultaneous deposition of different crystalline phases from the liquid phase saturated with respect to each constituent, and each retains its own crystalline form. An empirical equation has been obtained which is applicable to a wide range of silicate glasses and relates rate of crystal growth to the temperature and viscosity of the supercooled liquid phase. The curves show the crystallization behavior of devitrite, primary crystalline phase in a sheet glass composition, at various temperatures after different periods of heating (0.5, 0.75, 1, 1.5, 24 and 50 hours). The liquidus temperature for this glass was 965 deg. and the temperature of maximum crystal growth 910 deg. The devitrite: silica eutectic first appears at 850 deg.

Digest from "Crystallization in Silicate Slags and Glasses," by Eric Preston, *Transactions of the Faraday Society* 37, 209–20, 1941. (Published in England).

CRYSTALLIZATION OF TERTIARY PHOSPHATES

Tertiary phosphates of several metals have the peculiarity of crystallizing so slowly that precipitates of more soluble secondary phosphates sometimes appear ahead of the less soluble but less rapidly precipitated tertiary phosphates. Aside from theoretical significance this property has practical implications in water softening, in phosphatizing metals for corrosion prevention, in the setting of zinc phosphate cements and in the manufacture and fertilizing capacity of superphosphates. For example, the influence of temperature on rate of crystallization explains why fertilizers with soluble phosphoric acid can be applied in autumn without danger of fixation occurring too rapidly, but not in spring with summer temperatures approaching. Again, tertiary phosphates of aluminum and iron, adsorbed on hydroxide, have a high rate of crystallization which explains why soils rich in aluminum and iron rob a field of available phosphate much faster than do

Crystallization behavior of devitrite after different periods of heating



high calcium soils. Sodium phosphate is an effective softener only in hot water, since cold water will retain dicalcium phosphate in solution. The slow crystallization of zinc hydroxylapatite is involved both in the setting of zinc phosphate dental cements and in the necessity of hot solutions for phosphatizing iron.

Digest from "Low Crystallization Rate of Tertiary Phosphates," by Werner Rathje, *Berichte der deutschen chemischen Gesellschaft* 74, 546–52, 1941. (Published in Germany.)

FUEL IGNITION IN MOTORS

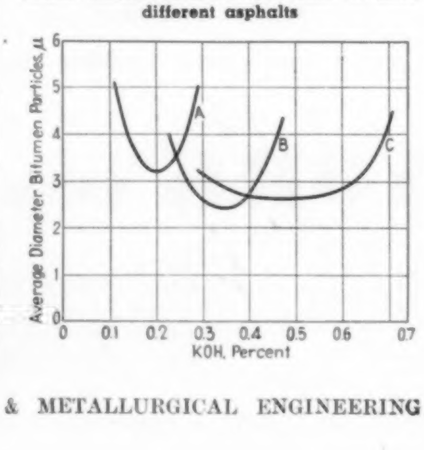
ELECTRICAL ignition of motor fuels has a complicated mechanism involving energies of excitation, dissociation and ionization. Hydroxy radicals, initially present in the fuel or formed by hydroxylation of hydrocarbons, are excited or ionized, not dissociated, by impact of electrons. Recombination of ions and electrons may be a source of radiant energy in electrical ignition. The time lag in electrical ignition has a constant and a statistically variable component. The constant component corresponds to building up the discharge potential. The variable component results from the necessity of initiating the discharge by loss of at least one electron. The degrees of dissociation and ionization needed for fuel ignition are calculated for the limiting case in which a transitory stationary state exists. The fundamental processes involved in ignition are discussed in relation to optimum ignition conditions and the factors involved in a quantitative study of ignition. Secondary electron production in the gas and at the cathode are important factors in promoting ionization. Aftereffects of preceding discharges and energy losses in the system are also factors to be considered.

Digest from "Physicochemical Problems of Igniting Gas Mixtures in Motors," by H. Zeise, *Zeitschrift für Elektrochemie* 47, 238–62, 1941. (Published in Germany.)

ASPHALT EMULSIONS

IN MAKING asphalt emulsions the relation of average particle size to alkali concentration is a fundamentally significant property. It may serve as a criterion of emulsifiability and yields useful information for proper compounding of emulsions according to the type of mill in which dispersion is to

Fig. 1—Relation of average particle size to alkali concentration for emulsions of three different asphalts



be effected. Average particle size, designated as the dispersion coefficient, gives entirely different curves when plotted against alkali concentration for readily emulsifiable and difficultly emulsifiable asphalts. This is illustrated by the curves for KOH concentrations up to 0.7 percent (Fig. 1) and up to 3 percent KOH (Fig. 2). In Fig. 1 asphalt A yields an acceptable

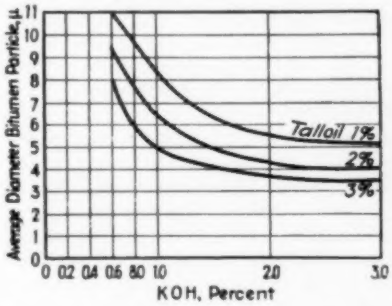


Fig. 2—Behavior of difficultly emulsifiable asphalt when tall oil is added to promote dispersion

emulsion at 0.2 percent KOH but is very sensitive to KOH concentration. Asphalt B yields finer emulsions (particle size less than 3 microns) over a somewhat wider range of KOH concentration. Asphalt C is much less sensitive to alkalinity but slightly inferior to asphalt B in fineness. Fig. 2 illustrates the behavior of a single difficultly emulsifiable asphalt when dispersion is promoted by adding 1, 2 or 3 percent of tall oil. Even with 3 percent tall oil and 3 percent KOH the desired fineness (3 microns) is not quite attained. The curves do not show a minimum and the dispersion coefficient does not even approach the desired fineness until higher KOH concentrations are reached than were required by asphalts A, B and C. Since asphalts which are difficult to emulsify also tend to yield inferior emulsions (both in performance and stability) the preliminary test would at once reject the asphalt of Fig. 2 as a candidate material for emulsions.

Digest from "Bituminous Emulsions: Preparation and Properties," by Hans Nüssel, *Bitumen* 11, 45–51, 1941. (Published in Germany.)

DEARSENIZING OXIDE ORES

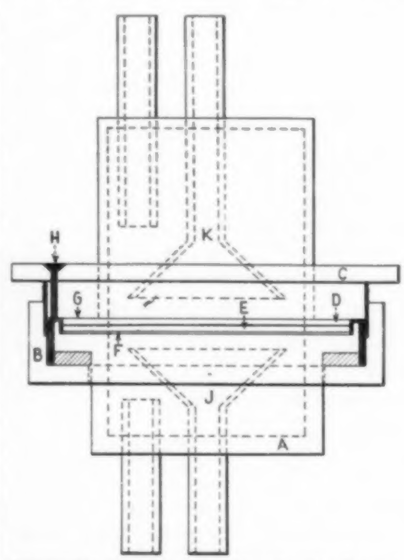
PRETREATMENT of ores cannot be reliably directed toward maximum dearsenizing effect unless the chemical reactions involved in forming volatilizable arsenic compounds are known and understood. For Fe oxide ores it must be remembered that As_2O_3 is more volatile than metallic As and that if Fe is allowed to reduce As_2O_3 to As there will be practically no dearsenization after the reduction since As dissolves in metallic Fe. In pretreating ores to expel As as As_2O_3 the temperature must be such as to facilitate vaporization of As_2O_3. An effective dearsenizing roast must be carried out with a relatively nonvolatile solid reducing agent so that the ore will not be reduced too soon. With a solid reducing agent such as wood

charcoal, lignite or semicoke there is danger of localized reduction unless the gas flow through air is fast enough to keep the liberated gas below the equilibrium concentration as temperature rises. By proper control of composition and conditions Fe oxide and Sn oxide ores can be dearsenized before reduction of the ore begins.

Digest from "Dearsenizing Oxide Ores," by Josef Klärding, *Archiv für das Eisenhüttenwesen* 14, 473–6, 1941. (Published in Germany.)

MOISTURE PERMEABILITY OF PAINT FILMS

AN IMPROVED apparatus has been developed for measuring the rate at which water vapor penetrates paint films, and with it measurements have been made with a variety of films under different conditions. A circular test film is placed between stainless steel rings, D and E, 1/16" thick, internal and external diameters 2" and 2–15/16" respectively, with surfaces plane within 0.5 mil. The rings rest in a recess in the brass support A which in turn rests on a fiber gasket (with waxed mercury-tight joint) in the brass cup B. Notches in the rings engage with pins to prevent distortion of the film by rotation of the rings, and two fine cross wires on the thin brass ring F under the steel rings prevent sagging of the test film. The top of the cell, C, is fixed in a wooden stand and the cell is assembled by screwing on the lower part until the flange G firmly contacts the upper ring D. The air space around the rings is filled



Apparatus for determination of rate of penetration of paint films by water vapor

with mercury so that moisture cannot leak around the edge of the film. Moist air enters the cell through cone J and dry air through cone K, at equalized rates of flow to avoid unequal pressures on the film.

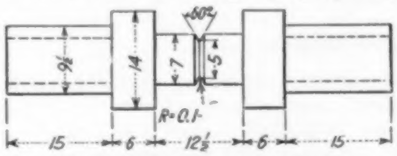
Tests with this apparatus show that moisture permeability is not merely inversely proportional to film thickness. Paint films, which dry by oxidation, have zones of different permeability while lacquer films, drying by

evaporation, are more nearly uniform. At moderate humidities permeability is practically proportional to the vapor pressure gradient, but it increases more rapidly at high humidities.

Digest from "Permeability of Protective Coatings to Water Vapor," by R. E. Lishmund and F. J. Siddle, *Journal of the Oil and Colour Chemists' Assoc'n* 24, 122–37, 1941. (Published in England.)

IMPACT STRENGTH TESTS

IN TESTING steels for impact strength notched or perforated test rods give a better distinction between brittle and tough steels than do solid test rods. Notched rods, if properly prepared,



Impact strength test specimen (dimensions in centimeters)

give a clear distinction and are superior to perforated rods for this test. The rod which was selected differed from the Charpy rod (open perforation notch) in having a single notch entirely around its circumference (see drawing).

Digest from "Impact Strength Test and its Uses," by K. G. Olsson, *Jernkontorets Annaler* 125, 249–73, 1941. (Published in Sweden.)

NEW DRYING OILS BY ESTER INTERCHANGE

PROCESSING drying oils by ester interchange, either in raw or boiled oils, yields products which save power in paint grinding and effect savings of 20 to 30 percent in drying oil consumption. Ester interchange involves an exchange between different glycerides, by reaction with each other or with glycerol, and may be effected catalytically. The pigment absorption capacity of the oil is increased, pigment particles disperse more readily and the oil spreads more smoothly. The treated oils are also superior in waterproofness and quality of impressions in lithographic and offset printing. Oils made by ester interchange have been prepared with linseed, grapeseed and perilla oils.

Digest from "Importance of Improving Oils and Stand Oils by Ester Interchange," by Carlos Eckmann, *Farben-Chemiker* 12, 34, 39–44, 63–6, 1941. (Published in Germany.)

SULPHUR DIOXIDE PRODUCTION

SULPHUR production in Germany has been greatly improved by new processes for recovering sulphur at very low concentrations from coke oven and coal distillation gases. To produce SO_2 for sulphite pulping the latest equipment feeds molten S to the burners from a tank heated by waste heat from the burners. A steam coil is also provided to melt the S when starting up. In some furnaces the melt is atomized into the combustion zone under pressure. Gas with SO_2 concentration as high as 15 percent

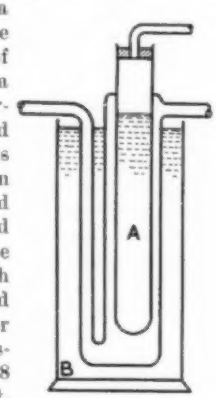
can be produced from a modern rotary sulphur burner. Use of lead pipe is still necessary in gas coolers since acid-resisting steels have not been able to meet the conditions. A common error is to make the coolers too small for their load; ample cooling capacity for all requirements is essential. There is still much need for improvement in scrubbers for purifying the gas. The principal difficulty is to find a sufficiently corrosion-resisting material for contact with the gas.

Digest from "Producing Sulphur Dioxide in Sulphite Pulp Mills," by A. Malik. *Zeitschift für Papier, Pappe, Zellulose und Holzstoff* **59**, 65-70, 1941. (Published in Vienna.)

LOW PRESSURE GAGE

A SIMPLE, inexpensive gage for manometric measurement of very low pressures utilizes the escape of CO_2 gas from a slush of solid CO_2 and ether. It lacks the precision of the more complicated and expensive Pirani and ionization gages but its simplicity and convenience commend it whenever an approximate estimate of very low pressures will suffice.

The inner CO_2 chamber *A* and the outer air-stirred ice bath *B* are separated by the vacuum to be gaged. The time required for a specified volume (20 to 50 cc.) of CO_2 to collect in a brine-filled gas burette is translated into pressure units from a calibration curve obtained with a McLeod gage and a pipette system. A smooth curve was obtained for example, for example, for pressures up to 0.008 mm. Hg when t_0 was 165 seconds and t_0–t ranged up to 80 seconds; t_0 is the longest time taken by a given volume of CO_2 to escape and represents the lower sensitivity limit of the gage. The lower sensitivity is in the pressure region in which conducted energy is negligible in comparison with radiated energy. By silvering the outer wall of *A* and the inner wall of *B* radiation to the CO_2 chamber is decreased and sensitivity is extended to lower pressures, but the gage is made slower in action.



Digest from "A New Low Pressure Gage," by C. C. Coffin and J. R. Dingle, *Canadian Journal of Research,* **19B**, 129–31, 1941. (Published in Canada.)

HAZARDS OF STATIC CHARGES

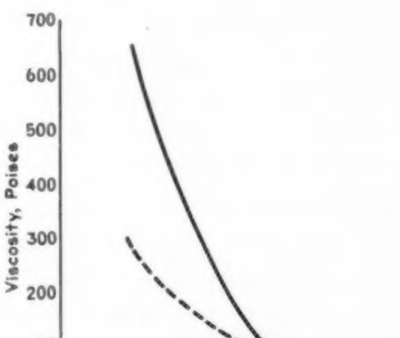
WHILE the static charge built up by a flowing liquid is proportional to rate of flow it decreases as pipe or orifice diameter increases. The material of which the pipe is made has little influence, but surface roughness has a large influence. Thus, a glass tube etched to a depth of 1/100 of the tube diameter accumulated five times the static charge found on the smooth

tube under like conditions. For a given liquid the charge is smaller the higher the electrical conductivity of the liquid, but different liquids cannot be compared with each other on this basis. Solids, such as conveyor belts, also build up static charges, even on grounded metal pulleys or rolls. Among the expedients for dissipating static charges to avoid sparking in explosive atmospheres are ionization of the air with x-rays, gamma rays, UV light or a glow discharge; increasing atmospheric humidity; preventing turbulence and spattering in flowing liquids; preventing friction, e. g. by using smooth pipes and orifices; increasing electrical conductivity, and decreasing flow of velocity, of liquids.

Digest from "Formation, Elimination and Hazards of Electrostatic Charges," by H. Nitka, *Chemische Fabrik* **14**, 211, 1941; based on Beiheft No. 42, *Zeitschrift des Vereins deutscher Chemiker*, 28 pp., 1941.

VISCOMETRY OF PRINTING INKS

The Hoppler falling ball viscometer is arranged to prevent turbulent fall of the ball through the liquid, while avoiding excessively slow descent. The tube is water jacketed and the water is electrically heated to maintain constant temperature. Often the heating current needs to be turned on only 15-20 seconds at a time. As applied to viscometry of printing inks this instrument gives accurate results and is convenient as well as relatively inexpensive. In view of the wide viscosity range of ink vehicles over a relatively narrow temperature range it is well to use two balls, with the faster falling ball below, when viscosity is to be measured over a range of temperatures. As temperature rises and the lower ball begins to fall too rapidly the readings are taken from the slower upper ball. The curves represent the viscosity: temperature relation for a linseed oil ink vehicle (dotted line) and a coumarone resin solution in a mineral oil solvent (solid line).



Viscosities of a linseed oil ink vehicle (dotted line) and a coumarone resin solution in mineral oil solvent (solid line)

Digest from "Viscometry of Printing Inks With the Höppler Viscometer," by Walther Kühn, *Farben-Chemiker* **12**, 31–3, 1941. (Published in Germany.)

New Titles, Editions and Authors

CHEM & MET BOOKSHELF

BIRD'S-EYE VIEW

HIGHER MATHEMATICS FOR ENGINEERS AND PHYSICISTS. Second edition. By *Ivan S. Sokolnikoff* and *Elizabeth S. Sokolnikoff*. Published by McGraw-Hill Book Co., New York, N. Y. 587 pages. Price $4.50.

Reviewed by *John H. Perry*

THIS is a second edition of the work that appeared as a first edition in 1934. In the Preface, the authors state that "the chief purpose of the book is to help to bridge the gap which separates many engineers from mathematics by giving them a bird's-eye view of those mathematical topics which are indispensable in the study of the physical sciences." The authors have succeeded in this purpose and also have successfully met the common complaint of engineers and physicists that there is usually "insufficient emphasis on the art of formulating physical problems in mathematical terms" in most presentations of advanced calculus and differential equations.

The number of pages in this edition, 587 pages, is 25 percent more than that of the first edition, 482 pages. The number of chapters has been reduced from 15 to 12 by the elimination of the first-edition chapters on Elliptical Integrals, Determinants and Matrices, Improper Integrals, and Conformal Representation. However, most of the pertinent subject matter of these deleted chapters is retained by incorporation in the 12 chapters of this edition. A new chapter on Complex Variable has been added. The new chapters are: Infinite Series, Fourier Series, Solution of Equations, Partial Differentiation, Multiple Integrals, Line Integral, Ordinary Differential Equations, Partial Differential Equations, Vector Analysis, Complex Variable, Probability, and Empirical Formulas and Curve Fitting.

The excellent material of the first edition has been improved materially in the present edition. This has been effected by a more effective order of subjects with (usually) slight elaboration in the text of specific sections and chapters and by the addition of many problems throughout the book. The authors state that "The illustrative material has been chosen for its value in emphasizing the underlying principles rather than for its direct application to specific problems that may confront a practicing engineer." The authors have, indeed, been scrupulous in delineating the principles involved. In addition, they should be credited with an excellent choice of problems and a fair and even distribution of the subject matter of their examples and problems among the various branches of engineering and of physics. A chemical engineer will find many examples and problems of usefulness to him in this book. The practical utility of this new edition as a rich source of reference may be judged by the number of examples (150) and problems (over 700) now available to the engineer and scientist.

The book is to be recommended to teachers, students, and practicing engineers and scientists.

BASIC DATA AND INFORMATION

PROTECTIVE AND DECORATIVE COATINGS. Vol. I, Raw Materials for Varnishes and Vehicles. By *Joseph J. Mattiello*. Published by John Wiley & Sons, New York, N. Y. 1941. 803 pages. Price $6.

THIS is the first of a three volume series dealing with what may be rightly considered the reborn field of protective and decorative coatings. The materials, manufacturing procedure, uses and methods of application have been undergoing rapid expansion and changes recently. However, the literature has not kept abreast of the progress, therefore, this treatise covering the statistics of the industry and a discussion of the developments meets a need that has existed for some time. The author states that the primary purpose of the book is to supply basic data and information pertaining to both types of coatings. It is intended to serve the needs of technically trained graduates who enter the industry and also to help older and more experienced technologists.

Due to the great breadth of the field Dr. Mattiello has not attempted to prepare the entire contents of the book but has wisely called upon the knowledge and assistance of a large number of men from the industry, each an authority on his own subject. This manner of handling the various phases of the subject assures reliable data and discussion of each one. However, it does have certain unfortunate consequences. Very naturally each authority treats only the one material in which he is a specialist and is in effect a salesman for that material. This treatment of the information and data on the various raw materials is satisfactory from the viewpoint of the experienced chemist or engineer but not so with the young man entering the coating industry, he finds it difficult to compare one material with another and is apt to be left in confusion.

While this volume is of primary interest to the coating industry its sphere of interest is much wider. Chemical engineers in other fields will find of value the chapters dealing with such subjects as drying oils, natural and synthetic resins, driers, thinners and solvents, and ethers for the authors have done a splendid job of bringing together all authoritative information and have covered the recent developments.

PLASTIC PRODUCTION

PLASTIC MOLDING. By *D. A. Dearle*. Published by the Chemical Publishing Co., Brooklyn, N. Y. 131 pages. Price $4.

PRACTICAL aspects of manufacturing were the primary consideration of the author in compiling this little book. Molding, finishing, presses and accessory equipment, costs, design, and production are discussed from the point of view of turning out the finished products with a minimum of rejects and as economically as possible. The discussion of the raw materials stresses molding requirements and applications and is primarily background material necessary for intelligent use of the remainder of the book.

A CONDENSATION OF PRINCIPLES

pH AND ELECTROTITRATIONS. Second edition. By *I. M. Kolthoff* and *H. A. Laitinen*. Published by John Wiley & Sons, New York, N. Y. 190 pages. Price $3.

DIVIDED into three sections, the first edition of this textbook covered acid-base indicators and colorimetric determination of pH, potentiometric determination of pH and potentiometric titrations, and conductometric titrations. Chapters in these sections have been revised in the light of advances made in the past ten years. And in addition, a fourth section on voltammetry and amperometric titrations has been added. The three chapters in the new section discuss fundamental principles of voltammetry, equipment and techniques used, and amperometric titrations. Although the volume is a textbook intended for college courses, it will serve as a guide and reference for instrumentation specialists.

THEORY AND PRACTICE

EMULSIONS AND FOAMS. By *S. Berkman* and *G. Egloff*. Published by Reinhold Publishing Corp., N. Y. 563 pages. Price $8.50.

Reviewed by *W. L. Abramowitz*

THE Universal Oil Products Co. is to be commended for their broad foresight in making available the results of their very thorough literature surveys. The collected data on emulsions are still meagre in spite of the fact that a constant increase in the patent and

scientific literature attests to the importance of the field. For example, the majority of synthetic rubbers are first produced in the emulsion state to give an artificial latex which is subsequently coagulated.

The field of emulsions and foams is still in a very formative state and though many hypotheses have been proposed, there is not yet available any really coherent theory which gives a complete and clear explanation of emulsion phenomena. There are so many variables present in the making of industrial emulsions that many of the data consist of isolated empirical facts. There still remains an urgent need for a critical collective study of emulsions phenomena. The authors have begun this in the summaries at the close of their first chapters.

The book comprises essentially three groupings (1) 151 pages of theory, (2) 214 pages of industrial practice, (3) 39 pages of laboratory methods. The theoretical section begins with the effects of surface tension on the formation and stability of emulsions. An understanding of surface tension phenomena is particularly important because an increasing number of commercial processes for making resin, wax, and oil emulsions are employing scientific utilization of surface tensions instead of the brute force of colloid mills and homogenizers to make excellent emulsions of very small particle size and great stability. The section on the stability of emulsions and phase inversion is well worth reading as is also the information on interfacial relationships and molecular orientations of emulsifiers in interfaces.

Foams may be considered as emulsions in which a gas is the dispersed phase and are created by many of the same conditions which give rise to emulsions. The study of foams because of their macro size and hence greater ease of observation as compared with emulsions has given much information on both types of systems and has been very fruitful. The flotation of ores, for example, has received great commercial impetus through the thorough study of the mechanism of foams and at present is particularly vital for national defense where the benefication of low grade ores is concerned. For many purposes, however, as in production of paper or manufacture of glue, foams are undesirable and much effort and money has been expended on defoamers. The chapter discusses the mechanism of and physical factors influencing the effect of electrolytes and protective colloids on stability of foam systems and the forces involved in maintaining stability.

The rest of the book deals with the so-called "practical knowledge of emulsions." Considerable space is devoted to abstracts of patents dealing with emulsifiers, but since there are some 2,000 U.S. patents alone on the subject, treatment is very difficult. As usually happens in such instances the examples are more intriguing from a patent lawyer's standpoint than from a chem-

'st's because many are impractical. However, the classes of compounds represented cover the available groupings and will repay some study. There is interesting information on emulsification equipment but the treatment is brief.

More than half of the book is concerned with the emulsion problems of the crude oil industry which the authors by reason of their affiliations and experience are well qualified to discuss. In many wells, the oil issues as an emulsion and the problem of separating oil from water is very acute. The chapters dealing with this phase are the most thorough and cover de-emulsification by heat, electrical methods, and chemical methods. The latter have had an eventful history because there has been a concerted, well-planned campaign by certain interests to cover with patents almost every composition of matter that would conceivably act as de-emulsifiers.

Two other classes of emulsions are intimately connected with the petroleum industry; asphalt and bituminous emulsions which are extensively used in road building, for making paints, waterproofing paper, roofing, etc., and lubricating oil emulsions such as certain types of cutting oils which are finding increased commercial application. The methods for emulsifying asphalt and bitumens are described and stress is given to their utilization in road construction. The chapter on lubricants and lubricating oil emulsions elaborates on the surface phenomena attending lubrication and lists some of the methods shown in the patent literature for preparing lubricating oil emulsions. The last section shows laboratory methods used in the examination of crude oil emulsions and describes the customary measurements of surface tension.

The book is definitely recommended to colloid chemists and particularly to industrial workers in the field of emulsions.

PHOTOMICROGRAPHY. By *R. M. Allen.* Published by D. Van Nostrand Co., New York, N. Y. 365 pages. Price $5.50.

THE MICROSCOPE is frequently regarded as being a tool for the biologist, botanist and physiologist rather than for the chemical engineer. It does, however, have definite uses in our profession beyond the familiar metallographic applications. The paint, paper, leather, textile and other industries use the instrument in routine testing as well as for research. Microfilm as a method of preserving files and records is increasing in use and importance. In reports, the use of photomicrographs can often convey an idea which otherwise might have to be exhumed from a long discussion and description.

A previous book by the same author discusses the use and applications of the microscope. (See *Chem. & Met.* Mar. 1940, p. 202.) Therefore, the

present work starts immediately with a discussion of the principles of photomicrography. Equipment, both commercially available and homemade, is described. Technique, processes, and materials are all adequately covered. A section of 50 illustrative photomicrographs with exposure and other data given, show what can be accomplished with various magnifications, filters, exposures, etc.

The usefulness of the book is increased by a comprehensive index and the numerous graphs and illustrations which are scattered throughout the text. It can be recommended, not only to microscopists, but also to engineers who wish to apply photomicrography to their control or research problems.

PHOTOELASTICITY. Vol. I. By *Max. M. Frocht*. Published by John Wiley & Sons, New York, N. Y. 411 pages. Price $6.

CONSIDERABLE work has been done in the last few years in advancing the technique of photoelasticity. This new volume will prove to be an important handbook and guide for all investigators in the field. Well illustrated with diagrams and photographs (some of which are in color) it covers theories of stresses and strains, optical problems involved, as well as the materials, models, equipment and other features of photoelastic measurements and studies. Volume II will include methods dependent on further experiments which do not employ transparent models.

RUBBER RED BOOK, 1941. Edited by *M. E. Lerner*. Published by Palmerton Publishing Co., New York, N. Y. 512 pages. Price $5.

LISTS of manufacturers, materials and machinery are included in this third issue of a biennial directory of the rubber industry. A short new section of synthetic rubbers and other rubber-like materials gives properties and producers of 14 products.

TECHNICAL REPORT WRITING. By *Fred H. Rhodes*. Published by McGraw-Hill Book Co., New York, N. Y. 125 pages. Price $1.25.

TO PREPARE a good report, according to Professor Rhodes, requires intelligent collection of data, understanding of the material to be presented, careful selection of that material, organization, and correct English. And in his new book are set forth many worthwhile ideas on these subjects.

In addition to the chapters on the importance, characteristics, organization and the form of good reports, there are chapters on laboratory notebooks, on oral presentation and on style, conventions and correct usage. Appendices give a list of references, conventions for use in sketches and flowsheets, and symbols commonly used.

One might argue that the included

directions for construction of nomographs and discussions of mathematical analysis of experimental errors, statistical methods and dimensional analysis are more adequately covered in other reference books and therefore are out of place in a text on report writing. This may be true. Nevertheless they, too, are in this volume for whatever use the reader wishes to make of them. All who are concerned with the preparation of reports of engineering or scientific investigations will profit by study of Professor Rhodes' book.

THE CHEMISTRY OF PULP AND PAPER MAKING. Third Edition. By *Edwin Sutermeister*. Published by John Wiley & Sons, New York, N. Y. 529 pages. Price $6.50.

PREVIOUS editions of this book were entirely the work of Mr. Sutermeister, but because conditions in the industry have changed with great rapidity in recent years it was felt that no one person could do justice to all the subjects which it was necessary to include. For this reason it was thought best to obtain the assistance of several collaborators, each of whom was an acknowledged authority in his particular line.

In an effort to bring the book up-to-date without increasing its size too greatly it was decided to minimize or omit the more common methods of analysis, the details of which can be found in other places, but to include those which are more specialized or less easily found.

This book deals primarily with the chemical aspects of the industry and embodies under one cover results of recent investigations. The endeavor has been to include all details which the chemist should have to enable him to grasp methods of manufacture. It is not intended to be a treatise on paper making in all its mechanical phases. It has been written principally with the idea of helping the young chemist and engineer.

RECENT BOOKS and PAMPHLETS

Index to A.S.T.M. Standards. Published by the American Society for Testing Materials, Philadelphia, Pa. The Society's annual publication of specifications, methods of testing, recommended practices, definitions, charts and tables. A list of Standards and Tentative Standards in numerical sequence is included.

Chemical Constitution of Portland Cement. By *Ary F. Torres*. 135 pages. Intended for a course in construction materials. Covers cementing materials in general, chemical composition and constitution of portland cement and the phase relations of its compounds, includes microscopic studies of cement constituents. Written in Portugese.

Compressed Gas Proceedings. The Compressed Gas Manufacturers Association's 28th annual report of its 1941 convention. Available from the Association, 11 West 42nd Street, New York City. Includes several technical papers, as well as committee reports.

Patent Background for Engineers. A 54-page booklet prepared by six authorities and published by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Designed primarily for engineers and executives who deal with inventions, the 15 articles in the booklet originally appeared in issues of the Allis-Chalmers *Electrical Review*. They discuss in nonlegal language the fundamentals of patents. Drawings, claims, fallacies, secrecy, joint inventorship, interference and many other aspects of patents and the securing of patents are discussed. A particularly interesting article is the one concerning trends of development in American patent law.

Doing Business With the Procurement Division. A 15-page pamphlet published by the Procurement Division of the Treasury Department, Washington, D. C. Tells how the Division buys and how to get on its mailing list. Discusses laws, invitations to bid, bonds required, awards, contracts, payment and other pertinent information. Includes a list of State and Regional Procurement offices.

Manual of Sugar Companies, 1941. 19th edition. Published by Farr & Co., New York, N. Y. 204 pages. Price $1. Features of previous editions have been continued in the 1941 manual. Full page reviews of 23 companies give earnings, production, officers and similar data. Synopses of more than 160 other companies are also given. Statistical tables and quota figures have been brought up to date.

A Century Ago. Published by E. B. Badger & Sons Co., Boston, Mass. A 38-page booklet prepared largely from the memoirs of E. B. Badger. Gives interesting accounts of his boyhood in Boston and of his apprenticeship and early experiences in the company which later was to bear his name.

GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. In ordering publications noted in this list always give complete title and the issuing office. Remittances should be made by postal money order, express order, coupons, or check. Do not send postage stamps. All publications are in paper cover unless otherwise specified. When no price is indicated, pamphlet is free and should be ordered from Bureau responsible for its issue.

Lime, by Oliver Bowles and D. M. Banks (revised by Duncan McConnell). Information Circular 6884R. Bureau of Mines; mimeographed.

Storage of Subbituminous Coal in Bins, by V. F. Parry and John B. Goodman. Report of Investigations 3587. Bureau of Mines; mimeographed.

Gas Explosions in Buildings: Their Cause and Prevention, by D. J. Parker and C. W. Owings. Information Circular 7142R. Bureau of Mines; mimeographed.

Temperatures of Natural-Gas Pipe Lines and Seasonal Variations of Underground Temperatures, by W. M. Deaton and E. M. Frost, Jr. Report of Investigations 3590. Bureau of Mines; mimeographed.

A Laboratory Study of Water Encroachment in Oil-Filled Sand Columns, by Frank G. Miller. Report of Investigations 3595. Bureau of Mines; mimeographed.

Inflammability of Ether-Oxygen-Helium Mixtures: Their Application in Anesthesia, by G. W. Jones, R. E. Kennedy, and G. J. Thomas. Report of Investigations 3589. Bureau of Mines; mimeographed.

Nonmetallic Minerals Needed for National Defense: 4. Building Materials, by Leo J. O'Neill. Information Circular 7179. Bureau of Mines; mimeographed.

Mechanical Concentration of Gases, by C. G. Maier. Bureau of Mines Bulletin 431. 20 cents.

Heat Treating and Inspection of

Metals. War Department Technical Manual TM 1-423. 10 cents.

Earnings and Hours in the Paperboard Industry. Departent of Labor, Bureau of Labor Statistics Bulletin No. 692.

The Toxicity and Potential Dangers of Nitrous Fumes, by W. F. von Oettingen, U. S. Public Health Service, Public Health Bulletin #272. 34 pages. 10 cents.

Development and Use of Baking Powder and Baking Chemicals, by L. H. Bailey. Department of Agriculture Circular No. 138. 5 cents.

Marketing Peanuts and Peanut Products, by Harold J. Clay. Department of Agriculture Miscellaneous Publication No. 416. 20 cents.

Hogs and Hog Products. Report No. 143, second series. U. S. Tariff Commission. 215 pages. 25 cents.

Business Research Projects — 1941. Economic Series No. 16. U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce. 20 cents.

Safety Rules for the Installation and Maintenance of Electric Supply and Communication Lines. National Bureau of Standards Handbook H32. 65 cents. Cloth bound. Supersedes H10.

Weights and Measures Administration, by Ralph W. Smith. National Bureau of Standards Handbook H26. 75 cents. Cloth bound. Supersedes H11.

Structural, Heat-Transfer, and Water-Permeability Properties of Five Earth-Wall Constructions, by Herbert L. Whittemore, Ambrose H. Stang, Elbert Hubbell, and Richard S. Dill. National Bureau of Standards, Report BMS78. 20 cents.

Handbook, Office for Emergency Management. Functions and Administration. Division of Information, Office for Emergency Management.

Paper and Paperboard Production and Paper-Making Machines in Use and **Wood-Pulp Production and Pulpwood Consumption,** reported jointly by Census of Forest Products: 1940. U. S. Department of Commerce, Bureau of the Census.

Census Reports. The Bureau of the Census is issuing at frequent intervals pamphlets which are preprints of chapters from the publications of the 1939-1940 Census. Those which relate to the Census of Manufactures are appearing in two series. One of these gives by industries the complete final figures. The second part, just beginning to appear, gives data by states.

Comparable pamphlets are being issued from time to time on the Census of Business. One of the more important groups of pamphlets recently issued deals with retail trade. These various pamphlets take up various types of trade and various functions and activities. One of the series deals with trade by commodities. Material of this sort is, in general, not of interest to chemical process industry, but may have occasional value. Edition of October 1, 1941.

Index of Specifications Used by the Navy Department for Naval Stores and Material. Navy Department, Bureau of Supplies and Accounts.

The Food and Drug Administration, Federal Security Agency Miscellaneous Publication No. 1. Describes organization and scope of work. 10 cents.

Standard Industrial Classification Manual. Volume I; Manufacturing Industries. Describes the new classification of industry which is prescribed for use of all Government departments in future statistical work. Bureau of the Budget, Executive Office of the President. 15 cents.

Federal Specifications: New or revised specifications issued under Federal Standard Stock Catalog now available include the following, available at 5 cents per copy: Barrels; Steel, Type 5, RR-B-116a. Turpentine; Wood (Destructively-Distilled) (For) Paint, LLL-T-792a. Cork; Compressed (Corkboard) (For Thermal Insulation), HH-C-561b. Leather; Harness, Black and Russet (Vegetable-Tanned) KK-L-171a. Tubes, Automobile and Motorcycle; Inner. ZZ-T-721c. Tubing; Rubber ZZ-T-83 lb.

Coal Paleobotany, by Reinhardt Thiessen and George C. Sprunk. Bureau of Mines, Technical Paper 631. 15 cents.

Inspection and Testing of Mine-type Electrical Equipment for Permissibility, by L. C. Ilsey, E. J. Gleim, and H. L. Brunot. Information Circular 7185. Bureau of Mines; mimeographed. Revision of Bureau of Mines Bulletin 305.

PROPOSED PUBLICATIONS
of the
U. S. OFFICE OF CIVILIAN DEFENSE

The following list of publications has been selected from those whose form and content has been approved as of August 1, 1941. There will be many others, but the following list will serve to indicate the scope of the work of the Training Aids Section of the office.

Distribution will be free to the approved list of the Office of Civilian Defense. All will be listed for sale through the Superintendent of Public Documents and may be obtained from that source by those not enrolled in the Civilian Defense.

Planning Guides—This series of publications will be intended for the guidance of responsible executive officers and will contain an outline of general procedure in the civilian defense program. Following is the tentative schedule of approved subjects:

1. Local Organization for Civilian Protection
2. Emergency Medical Services for Civilian Protection
3. Protection of Industrial Plants and Public Buildings
4. Enrolled Volunteer Services for Civilian Protection—Insignia and General Duties
5. Blackouts
6. The Civilian Air Raid Warning System

Memoranda—A series of publications intended for the guidance of executives and professional consultants. Will define basic procedures or offer suggestions for the solution of those problems which are in a state of development. To be issued as adopted.

1. Suggested Guides in Municipalities in Regard to Defense Communication Matters

Text Books—This series of publications will be intended for the use of instructors and technicians, and it is proposed that each will be a complete exposition of one particular phase of civilian defense. The text, technical in nature but simplified as far as possible will be prepared by the War Department or other recognized authority and will be edited and designed by the Office of Civilian Defense. Following is the tentative schedule of proposed publications:

1. Protective Construction (Structures Series No. 1)
2. Protection Against Gas
3. Defense against Incendiary Attack—Methods, Equipment, Forces
4. Medical Treatment of War Gas Casualties
5. Camouflage and Dummy Lighting

Handbooks—This series of publications is intended for the use of the individual enrolled worker and will include key facts from material presented in the text-book series. Tentative plans are that handbooks will be prepared for the use of Air Raid Wardens, Auxiliary Firemen, Auxiliary Police, First Aid Parties, Rescue Parties, Decontamination, Welfare Workers, Messengers, Nurses' Aides, Emergency Drivers.

Civilian Instruction Pamphlets—This series of publications is intended for the use of the civilian as well as for the use of those enrolled in the civilian defense organization. Constituting the simplest possible instruction in civilian defense methods, it will appear in continuity strip style in picture and caption. Tentative plans include pamphlets on the following subjects:

1. Badges, Symbols and Uniforms for Air Raid Protection
2. Fighting the Fire Bomb
4. Where to go During an Air Raid
5. Emergency First Aid.
7. How to Protect Yourself From War Gas

Civilian Defense School Memoranda—This series of publications is intended for the use of instructors trained at Schools and will supplement the material contained in the Text-Book Series. Based on material presented at the Civilian Defense School conducted at Edgewood Arsenal, Maryland, its distribution will be limited to organized defense Schools throughout the country. It is intended that memoranda will be prepared on the following subjects:

1. Handling Incendiaries
2. Chemical Agents
3. The Service Mask
4. Decontamination
5. Meteorology and War

MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Air Treatment. Surface Combustion Corp., Toledo, Ohio—Forms K411, 2, 3—Three 4-page bulletins on this concern's methods for humidity control for processing atmospheres by use of its "Kathabar" system. Contains a brief discussion of the merits of the system and a simple flowsheet showing operating principles.

Ball Mills. Abbe Engineering Co., 50 Church Street, New York City—Catalog 55—16-page catalog dealing with this concern's pebble and ball mills. Contains brief descriptive material, photographs, specifications and similar information on the various units. Also Bulletin 56 dealing with the concern's new line of jar and bottle rolling machines for batch grinding or mixing process materials of all kinds.

Ball Mill Liners. American Manganese Steel Co., 388 E. 14th St., Chicago Heights, Ill.—8-page reprint dealing with use of this concern's alloys for ball mill liners. Contains engineering data on actual installations.

Bearings. Johnson Bronze Co., New Castle, Pa.—Catalog L3—36-page catalog of this concern's self-lubricating bronze, standard sizes of bushings and bearings, listing more than 2,000 sizes. Gives extensive engineering information on methods of installation, progressive size listings as well as other useful data on plain, flanged and spherical bearings and bushings.

Cast Iron. Gardner-Denver Co., Quincy, Ill.—24-page catalog on this concern's "GarDurloy" high-strength cast iron, its manufacture, quality and control, metallographical structure and applications for various engineering purposes. Gives tables on mechanical properties of the various alloys.

Catalysts. Baker & Co., Inc., 113 Astor St., Newark, N. J.—Bulletin 2849—6-page booklet entitled "Platinum Metal Catalysts" which gives notes on the use of these catalysts, a list of their most active available forms, and recommendations for various conditions of reaction. Also contains a brief bibliography of literature references on platinum catalysts in the chemical industry.

Ceramics. American Lava Corp., Chattanooga, Tenn.—10-page reprint entitled "The Electrical Properties of High Frequency Ceramics," which gives engineering information on this subject in both text and chart form. Includes numerous illustrations and an extensive chart on properties of ceramic insulating materials of this concern.

Chemicals. Carbide and Carbon Chemicals Corp., 30 East 42nd St., New York—20-page folder on this concern's glycols. Discusses and gives properties of ethylene glycol, diethylene glycol, triethylene glycol, propylene and dipropylene glycols. Contains information on specifications, containers, and industrial uses as anti-freezes, coupling agents, humectants, liquid coolants, etc. Contains extensive charts and references of the technical literature of these chemicals.

Chemicals. Glyco Products Co., Inc., 230 King St., Brooklyn, N. Y.—112-page catalog giving extensive information on the chemicals put out by this concern, such as polyhydric alcohol esters, emulsifying agents, flameproofing and waterproofing agents, synthetic resins and waxes. Contains comprehensive tables outlining specifications of these materials, suggested formulas, various suggested uses for each of the chemicals as well as information on shipping containers. Also contains various useful tables of conversion factors and physical characteristics.

Chemicals. Koppers Co., Tar & Chemical Division, 2000 Koppers Bldg., Pittsburgh, Pa.—Form XI—8-page folder which summarizes this concern's important products, plants and services, ranging from coal and coke to light oil plants and purification systems, couplings and piston rings, roofing, tar-base paints, pressure-treated timber products, tar acids and oils and coal tar solvents. Includes a brief discussion of uses, applications, and specifications.

Chemicals. Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa.—8-page folder on the "Orthosil" cleaner put out by this concern for heavy duty cleaning of ferrous metals. Contains information on properties of this orthosilicate and its solutions as compared to other silicates and alkali cleaners. Also information on how to use the material for various cleaning operations. Illustrated by color charts.

Chlorine. Pennsylvania Salt Mfg. Co., 1000 Widener Building, Philadelphia, Pa.—Data Book 3—48-page booklet, 6th edition, which gives technical information on properties, packaging, safe handling and uses of chlorine. Also includes information on piping and fixtures, handling tank cars, preparation of calcium and sodium hypochlorites, analytical methods, handling chlorine leaks, safety and first-aid measures, critical review of chlorine specifications, and purification of chlorine. Contains extensive engineering data in table, chart, and diagram form.

Colloid Mills. Premier Mill Corp., 110 E. 42nd St., New York City—Catalog C415—14-page catalog on this concern's colloid mills, with discussion of outstanding features, illustrations of various units, capacities and specifications and similar engineering information.

Control Instruments. The Brown Instrument Co., Wayne & Roberts Aves., Philadelphia, Pa.—Catalog 8301—56-page catalog on this concern's industrial control devices for temperatures, pressures, flows, liquid levels and humidity. Contains photographs and drawings of each unit, detailed information on models and specifications, special features, uses for various purposes, and engineering information on thermostats, float switches, safety shut-off valves, solenoid valves and air-operated valves.

Control Instruments. The Brown Instrument Co., Wayne & Roberts Aves., Philadelphia, Pa.—Bulletin 364—8-page folder entitled "Temperature Control Systems for Fuel-Fired Galvanizing Kettles." Describes three types of this concern's control systems, schematic diagrams showing how the systems are applied, and a review of principles of operation and types of instruments used.

Control Instruments. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.—Catalog N-58-161—28-page catalog on this concern's Micromax telemetering and totalizing recorders for electric power. Describes control equipment for these uses and discusses the use of load recorders by isolated utility and industrial power plants, power consumers as well as applications in system load-dispatching. Illustrated by photographs of units and installations, and useful flow circuits.

Control Instruments. Mason-Neilan Regulator Co., 1197 Adams St., Boston, Mass.—Catalog 41—24-page catalog on this concern's automatic control equipment, with illustrations and technical data on flowmeters, pressure recorders, pump pressure regulators, control valves, thermometers, and similar items. Photographic and drawing illustrations, discussion of uses of various units, and capacities and specification data tables are also included.

Crushers. Allis-Chalmers Mfg. Co.,

Milwaukee, Wis.—Bulletin B6006B—16-page bulletin on this concern's type "R" reduction crusher with speed-set product control. Contains numerous sectional views and actual installation photographs, together with brief descriptive material and capacity and dimension tables.

Dyestuffs. Calco Chemical Division, American Cyanamid Co., Bound Brook, N. J.—8-page booklet entitled "Priorities and the Dyestuff Industry." Discusses set-up of the Office of Emergency Management, the priorities critical list, critical items versus dye manufacture, the coming allocation system, and three examples of shortages of certain chemicals upon production of dyestuffs.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publication GEA3660—12-page folder which explains in detail the design, construction and application of this concern's new 2,300-volt contactor motor starter which can be safely applied to high capacity power circuits, and designed for use with squirrel-cage, synchronous and wound-rotor motors. Extensively illustrated.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publication GED-978—8-page folder entitled "Electric Equipment for the Chemical Industry" which describes and illustrates electric equipment such as motors, motor controls, power conversion equipment, and electric apparatus for materials handling, as well as voltage transformers, instruments and automatic process timing switches. Illustrated.

Electrical Equipment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Booklet B3024—40-page bulletin describing this concern's ignitron rectifiers in the 250-900 volt range for use in electrochemical, mining transportation and steel mills. Discusses design, construction, operation, auxiliaries, and includes typical illustrations of installations and a number of diagrams and graphs. Also Leaflet B3020, describing crane controls for hoist motors up to 330 hp. Wiring diagrams are used to show the comparison between the conventional and the circuit described.

Electric Motors. Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo.—Bulletin MU183—34-page bulletin on this concern's single-phase, direct-current and small polyphase motors. Contains detailed descriptions of the construction of repulsion-start-induction motors, split-phase and other type motors and includes photographs, diagrammatic drawings, descriptive material, and engineering information on the various types.

Electric Tools. Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill.—Catalog 37—65-page, 1942 catalog issued by this concern on its drills, grinders, hammers, saws, and other portable electric tools. Gives complete descriptions, specifications and prices on the entire line as well as photographic illustrations and engineering tables.

Electrolytic Metal Working. Burgess Battery Co., Handicraft Division, 500 W. Huron St., Chicago—12-page illustrated booklet entitled "The Electrolick Work-Shop, a New Handicraft" which gives general information on the "electrolytic" drilling, cutting, and turning of metals by a novel method and simple apparatus. Gives directions for handicraft experimentation, apparatus and supplies required, and results that can be obtained.

Engineering Tables. The Watson-Stillman Co., Roselle, N. J.—Bulletin 120A—12 pages of engineering tables on capacities of hydraulic rams, data on moments of inertia of rectangles, specific gravities and weights of various materials, strength of materials, conversion tables, and similar items, including useful mathematical formulas.

Equipment. Alsop Engineering Corp., Milldale, Conn.—Catalog 941—36-page catalog on this concern's equipment for liquid processing, including various types of agitators, bottle fillers, cappers, filters, mixers, pumps and tanks. Includes numerous installation photographs.

Equipment, Haveg Corporation, Newark, Del.—8-page folder describing this concern's corrosion-resistant chemical

equipment made of plastic material, including tanks, towers, fume ducts, pump and fan parts, and pipe and pipe fittings. Includes a discussion of fundamental design features, table of chemical resistance of Haveg, and standard sizes and designs of various other similar equipment.

Equipment. Oliver-United Filters, Inc., 33 W. 42nd St., New York City—Bulletin 308—6-page folder illustrating and describing briefly the "Olivite" pump for handling hot or cold acids and corrosive solutions. Also Bulletin 123, which deals with the concern's pressure filter for use on chemicals, dyes, syrups and other liquids. Includes photographs, diagrams, and engineering data on capacities and dimensions.

Equipment. S. Blickman Inc., Weehawken, N. J.—14-page booklet dealing with types of stainless steel for use with processing equipment. Contains special information on round corner construction in processing vessels and facts about welding technique. Extensively illustrated by photographs and diagrammatic sketches.

Gasoline. Foster-Wheeler Corp., 165 Broadway, New York City—Bulletin O-41-13—8-page bulletin describing the Shell isomerization process for producing isobutane, including a short description of the process, a simplified flow diagram for the process of converting normal butane to isobutane and a discussion of catalysts used, yields, side reactions, and equipment.

Instruments. General Electric Co., Schenectady, N. Y.—Bulletin GEA3680—8-page folder describing and illustrating outstanding features, advantages and specific uses of this concern's recording photoelectric spectrophotometer for graphic measurement of color. Includes schematic diagram of an installation, a typical color-analysis chart, and a list of potential uses in various inductries.

Instruments. Leeds & Northrup Co., 4901 Stanton Ave., Philadelphia, Pa.—Bulletin E94—70-page bibliography on the "Polarized Dropping Mercury Electrode." Contains references back to 1903 from all languages and includes both direct and related subject matter relative to theory and specific applications. First section contains a complete bibliography arranged both chronologically and alphabetically according to authors; the second is arranged by applications under 19 classifications. Nearly 800 references are included.

Ion Exchange Resins. The Resinous Products & Chemical Co., Philadelphia, Pa.—24-page loose-leaf notebook on "The Amberlites," synthetic ion exchange resins put out by this concern. Includes data on applications for various purposes and a description of the various types of synthetic ion exchange resins available together with methods of examination of exchange capacity of zeolites and such resins. Also contains three reprints dealing with synthetic resins as exchange absorbents which contain extensive data in table and chart form.

Nitroparaffins. Commercial Solvents Corp., 17 E. 42nd St., New York City—42-page booklet entitled "The Nitroparaffins—New Worlds for Chemical Exploration." Describes the nitroparaffins developed by this concern and a number of useful derivatives. Contains extensive information on present and potential industrial uses, physical and chemical properties, nitroparaffins as solvents, chemical reactions, and other similar useful information. Attractively illustrated.

Plastics. Bakelite Corporation, 30 E. 42nd St., New York City—31-page loose-leaf notebook on this concern's vinylite plastic sheet and sheeting materials. Includes extensive information on industrial applications and useful data on various sheet forms of vinyl resins, plasticized sheeting, unplasticized sheets, film, and plastic fabrics. Extensively illustrated.

Pumps. Lawrence Machine & Pump Corp., 371 Market St., Lawrence, Mass.—Bulletin 2062—4-page folder which describes this concern's non-clogging sewage and sludge pumps. Includes general descriptive material, photographs of various units, cross-sectional drawings and tables of capacity and diameter ranges.

Reclaiming Rubber. Robinson Mfg. Co., Muncy, Pa.—Catalog 37A—8-page catalog entitled "Processing Machinery for Reclaiming Rubber" which deals with crushers, knife-cutters, roll-feeders, hammermills, sifters, grinding installations, and other machinery used for this purpose. Contains photographs, general descriptive material and specifications.

Rotameters. Fischer & Porter Co., Hatboro, Pa.—Catalog Section 51B—8-page section entitled "Rotamatic Automatic Flow Controllers" which deals with this concern's new Rotameter for measuring and controlling flow of viscous or corrosive fluids which cannot be otherwise controlled. Contains photographs, sketches and general descriptive material.

Thermometers. The Brown Instrument Co., Wayne & Roberts Aves., Philadelphia, Pa.—Catalog 9004—32-page catalog on this concern's resistance thermometers for indicating, recording and controlling. Illustrates and discusses briefly the various types of thermometers, their specifications and advantages, standard accessories, special features and similar information.

Valves. The Edward Valve and Manufacturing Co., Inc., East Chicago, Ind. —Catalog 12, Section C—56-page new section issued by this concern describing its line of cast steel valves. Includes design, dimensional and metallurgical descriptions of cast steel stop, check and stop-check valves of various types and sizes. Also describes the concern's Impactor hand-wheels, throttlers, by-passes and contains data on flange facings, valve usage, current pressure-temperature adjusted service ratings, etc. Illustrated by drawings.

Water Treating. American K.A.T. Corp., 122 East 42nd St., New York City—First issue of this concern's house organ entitled "Water Marks" which will be published to give developments and results obtained in the treatment of water for boilers, stills and evaporators, with special reference to the use of organic colloids for such treatment.

Water Treatment. D. W. Haering & Co., Inc., 205 W. Wacker Drive, Chicago, Ill.—4th edition, 28-page booklet entitled "Organic Methods of Scale and Corrosion Control." Discusses organic chemicals in water conditioning, explanation of causes of scale and corrosion, physical and chemical properties of the various glucosates developed by this concern, and analytical and control procedures. Illustrated by charts, photographs, and drawings.

Water Treating. Graver Tank & Mfg. Co., East Chicago, Ill.—Form 307—12-page booklet which describes zeolite water softeners. Includes descriptive material on the zeolite process, the various types of this concern's zeolites, practical applications, hydrogen zeolites, and six methods for softening water with zeolite. Contains photographs of installations.

Water Treating. Permutit Co., 330 W. 42nd St., New York City—Bulletin 2420 —12-page folder which deals with the Permutit supplementary treatment of boiler feedwater. Includes general discussion of the phosphate feed and method of feeding, as well as the feeding of sodium sulphite for oxygen removal in feedwater Contains numerous useful diagrammatic sketches.

Welding. Eutectic Welding Alloys, Inc., 40 Worth St., New York City—32-page booklet entitled "Low Temperature Welding with Castolin Eutectic Alloys and Fluxes," and includes oxy-acetylene torch, gas, furnace or arc welding. Gives extensive engineering information and complete description of this concern's alloy rods as well as information on fabricating machine parts, replacing plastics and forgings. Also deals with salvaging of defective castings, as well as aluminum and bronze, alloy steel and particularly cast iron. Illustrated.

Welding. Air Reduction Co., 60 East 42nd St., New York—8-page folder entitled "Electrode Consumption Calculator" for arc welding any type of joint with either bare or coated electrodes. Describes method of calculating pounds of electrodes per linear foot of weld, and includes consumption figures amount of steel deposited, and basic formulas used in calculation.

CHEM & MET ECONOMICS & MARKETS

WAR-TIME DEMANDS WILL AFFECT CONSUMPTION OF CHEMICALS IN CIVILIAN INDUSTRIES

WHILE the operation of a defense program last year caused dislocations in general lines of industry due to preferences given to raw materials and finished products essential for military purposes, the change over to a complete war footing last month has made it evident that adjustments of a major scale must be made in the present year. The magnitude of the revised military program as disclosed early this month is a clear indication that demand for the wide variety of materials and goods which enter directly and indirectly into a war program will be so greatly in excess of anything yet experienced that every expedient must be employed to make them available for the most essential uses. Effects of this condition already have become manifest. Chlorine and toluol have come under complete distributional control; limitations have been placed on the amounts of alcohol and derivatives which each consuming industry may receive monthly. Methanol has been prohibited in the anti-freeze trade except where its use is required for our government or of other governments working in accord with our own. As need for materials becomes more pressing, it may be expected that allocations will be greatly extended with corresponding industry dislocations.

Chem. & Met. Index for Industrial Consumption of Chemicals
1935 = 100

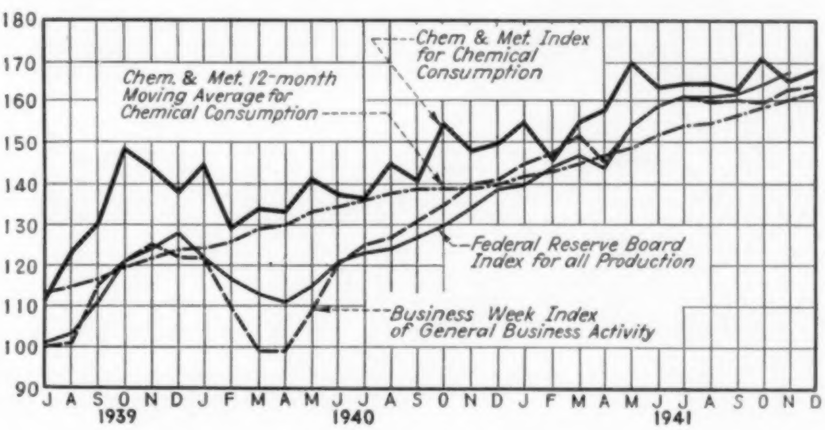
	Oct. revised	Nov.
Fertilizers	32.30	32.00
Pulp and paper......	22.60	22.33
Petroleum refining...	15.76	15.68
Glass	15.96	15.10
Paint and varnish...	16.60	13.43
Iron and steel........	12.70	12.71
Rayon	14.70	13.30
Textiles	12.22	10.80
Coal products........	9.45	9.26
Leather	5.20	4.80
Explosives	5.96	5.47
Rubber	3.99	3.80
Plastics	4.04	3.95
	171.48	162.63

In attempting to establish the future status of civilian industries, it is well to distinguish between that term in its present significance and what it was under normal conditions. Many of the so-called civilian industries now directly or indirectly fit into the whole scheme of war-time planning. To understand this more fully, we may run through the list of the manufacturing lines which in the past have been the main consumers of chemicals. Whether it be fertilizers, pulp and paper, textiles, rayon, plastics, rubber, paints, lacquers, dopes, iron and steel, explosives, leather, or rubber, all are in the essential classification and the products of these industries will be needed this year in volumes larger than ever before. While the amounts of such products made available for ordinary use undoubtedly will be lowered, it seems equally certain that losses in that direction will be more than offset by the larger amounts required for essential purposes.

Reverting to industrial consumption of chemicals in the closing weeks of last year, it is found that some of the large manufacturers had slowed operations somewhat. For instance some of the pulp and paper mills were undergoing repairs. Demand for paints and varnishes fell off partly through seasonal influences and partly because of reduced operations at automotive plants. The call for many products, however, gained ground and the weighed index for chemical consumption rose to close to 168 in December compared with a revised figure of 162.63 for November. In 1940, the corresponding indexes were 150.02 and 148.18 respectively.

From data now available, consumption of chemicals last year was approximately 63 percent larger than it was in 1935. This does not take into account the chemicals consumed directly in the manufacture of munitions and in other lines of a direct military nature. Nor does it make allowance for the large increase in exports of chemicals. Hence the increase in production was considerably larger than that reported for consumption. To attain this large output chemical plants were worked at capacity—some of them above rated capacity—and to fill the enormous demands of 1942 plant capacities must be enlarged and the year should be notable for the fact that chemical plant construction was greater than in any previous year in the history of the industry.

Detailed figures for exports and imports of chemicals and related products are no longer made public, the September totals being the last to appear. However, active demand has been reported for many chemicals on the part of exporters and it is probable that the outward movement is still of large proportions. The import situation has been complicated by difficulties in shipping from the Far East and this has been notably manifest in the vegetable oil trade. If the shutting off of oil imports is prolonged larger yields of domestic oils will be necessary and if both coconut oil and copra are not available, production of glycerine may be curtailed at a time when it is most needed.

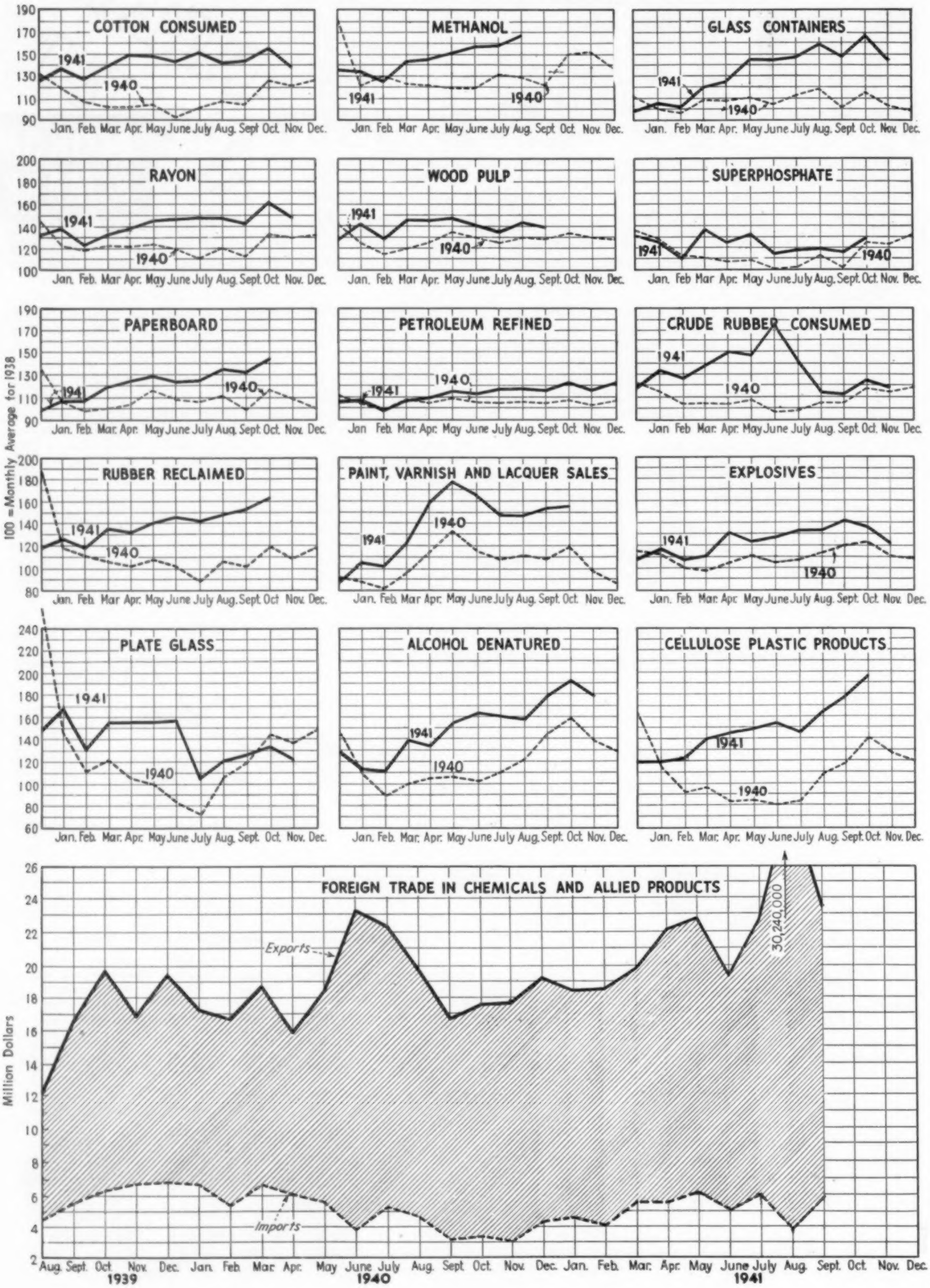


Production and Consumption Data for Chemical-Consuming Industries

Production	November 1941	November 1940	January-November 1941	January-November 1940	Percent of gain for 1941
Alcohol, ethyl, 1,000 pr. gal........	37,541	23,347	336,781	239,412	40.7
Alcohol denatured, 1,000 wi. gal....	16,965	13,154	159,477	122,018	30.7
Automobiles, no..................	352,347	487,352	4,556,187	3,913,778	16.4
Byproduct coke, 1,000 tons........	4,833	4,764	53,227	49,110	8.4
Ammonia liquor, 1,000 lb.	5,465	5,381	58,123	51,964	11.8
Ammonium sulphate, tons.........	62,190	55,478	680,596	646,300	5.2
Toluol;					
Nitration grade, 1,000 gal.......	1,264	1,134			
Pure, commercial 1,000 gal......	951	1,330	26,430	....	....
Other grades, 1,000 gal.........	137	40			
Naphthalene, 1,000 lb............	6,540	6,972	76,572	....	....
Phenol, 1,000 lb.................	1,781	1,619	....	....	....
Glass containers, 1,000 gr..........	6,179	4,351	64,390	50,060	28.6
Plate glass, 1,000 sq. ft...........	14,277	16,059	180,093	146,880	22.6
Pyroxylin spread, 1,000 lb..........	6,523	5,776	75,718	54,194	39.7
Consumption					
Cotton, bales....................	849,733	741,170	9,696,224	7,278,371	33.2
Silk bales.......................	5,676	36,374	197,711	289,754	31.7*
Wool, 1,000 lb...................	51,464	42,790	582,677	364,485	59.9
Explosives, 1,000 lb...............	37,486	34,444	421,197	373,210	12.9

* Percentage of loss.

Production and Consumption Trends



PRICES FOR CHEMICALS AND OILS MOVE UPWARD AS A RESULT OF REVISIONS IN PRICE CEILINGS

Main developments of market significance in recent weeks have centered around actions of governmental agencies in the way of price controls and regulations involving deliveries of raw materials and finished products. While jurisdiction over prices has been assumed principally for the purpose of stabilizing values or at least of preventing undue advances, the latest official rulings have, for the most part, resulted in upward revisions in sales schedules in order to stimulate the rate of output. On December 11, producers of acetone, butyl and ethyl alcohol were asked to refrain from quoting on those products for delivery after Jan. 1. Nine days later new maximum price levels to take effect on the first of the new year were announced. Original ceiling for acetone was 7¢ a lb. in tanks, delivered in eastern territory. The amended schedule is 15.8¢ a lb. The butanol ceiling was raised from 10¾¢ a lb. in tank cars delivered to 15.8¢ a lb. Maximum for ethyl alcohol which had been set at 24½¢ a gal. for the basic formula, "SD 2B" was moved up to 50¢ a gal. at works. Maximum prices for acetone and butanol when delivered from local stocks maintained by others than producers may be increased by 1¢ a gal. This is a new provision designed to assist dealers and jobbers.

Also effective on Jan. 1, producers of amyl alcohol from pentane announced a new price schedule quoting tank cars at 13.1¢ a lb., carlots in drums at 14.1¢ a lb. Amyl acetate, in the same schedule is now quoted at 14.5¢ a lb. in tank cars and at 15.5¢ a lb. for drums, carlots. These quotations are on a basis fob producing points, freight allowed east of the Mississippi River. OPA also announced the establishment of a uniform ceiling for acetic acid of any origin following three months observation of the operation of the original schedule which set maximum prices of 7¼¢ a lb. for acid of wood origin and 6¼¢ a lb. for acid of other origin. The uniform price is 6.93¢ a lb. in tank cars, fob works. In the case of export sales, excepting to Canada and Mexico where domestic ceilings will apply, the maximum may be increased by 3¢ per 100 lb. on amounts less than 5,000 lb.; 1½¢ per 100 lb. up to 25,000 lb.; and 1¢ per 100 lb. on quantities where more than 25,000 lb. are involved. Concentrations of technical and pure acetic acid in the eastern territory are quoted as follows, on basis fob shippers point: 28 percent, \$3.38; 56 percent, \$5.58; 70 percent, \$6.68; 80 percent, \$7.47; 84 percent, \$7.79; and glacial \$9.15, all being per 100 lb. in car lots packed in drums or barrels. Announcement of a rise of 25¢ per 100 lb. for bleaching powder was made last month and it was followed by the statement that the price had been stabilized by agreement with the individual producers thus making current quotations for car lots in drums, \$2.25 per 100 lb. for 800-lb. drums; \$2.50 for 333-lb. drums; and \$3.10 for 100-lb. drums.

Other developments touching on the price situation were found in a higher schedule for zinc oxides and lithopone, lactic acid, extension of individual agreements to stabilize prices for dry colors up to April, continuation of sulphuric acid prices over the first quarter of the year, withdrawal of proposed increase of 1¢ a lb. for titanium pigments, reduction in quotations for pyrophosphate for the first quarter, and the request that no sales of carnauba, beeswax, candelilla, and ouricury wax be made at prices higher than were in effect on Dec. 18 and importers were asked not to make purchases for import at prices in excess of foreign import levels prevailing on the same date.

Toward the middle of last month prices for vegetable oils had started to climb and official recognition was given in the way of establishing ceilings at the levels current on Nov. 26. This had the effect of causing a halt in trading and industry protests were effective enough to bring about a modification of the order whereby values prevailing on Oct. 1 were taken as the ceiling limits. A limit of 90 days supply likewise is placed on inventories of consumers. In some respects, this control over prices and distribution of oils is largely offset by the fact that the change in the situation affecting ocean deliveries has made uncertain the continuance of the movement of foreign oils from points of origin and a nominal price condition is reported for some of these oils which may be expected to continue until the import situation has been clarified. In the meantime, demand for domestic oils will broaden to make up for the loss in imports.

All chlorine produced in the United States will be subject to direct allocation after Feb. 1. War demands for chlorinated products have accentuated the shortage of chlorine which was the occasion for placing chlorine under full priorities control on July 28, 1941.

To facilitate allocation, a new type of requirement is now provided for sched-

CHEM. & MET.
Weighted Index of
CHEMICAL PRICES

Base=100 for 1937

This Month	**109.01**
Last month	103.85
January, 1941	100.00
January, 1940	98.72

Government action in raising maximum prices for many chemicals brought about an increase in the index number and the January index shows the highest average level since the latter part of 1930.

uling orders for chlorine. Regardless of priority ratings, no producer of chlorine may accept orders after the 10th day of any month for delivery in the next calendar month without a specific direction from the Director of Priorities.

No distributor of chlorine may accept orders after the 5th day of any month for delivery in the following month without specific direction from the Director of Priorities.

All toluene production was placed under strict government allocation regulations by OPM order on Dec. 30, in a far-reaching amendment to Priorities Order M-34. Beginning Feb. 1, producers are required to so operate their plants as to produce a maximum amount of nitration grade toluene; in no case may nitration grade drop below 70 percent of total output. Deliveries of nitration grade may be made only upon specific authorization of the Chemicals Branch, acting under Nelson's authority. Proposed shipments of commercial grade must be filed with the Chemicals Branch monthly by the 15th day of the month preceding deliveries for OPM approval. Also after Feb. 1, no toluene may be shipped for use as a diluent for protective coatings. Nitration grade toluene is defined by the order as production which meets the requirements of Grade A in U. S. Army specifications.

The synthetic rubber order, M-13, was amended on Jan. 2 and extended by the Director of Priorities. While the language of the Order is changed, the only actual changes in its effect are to include in its provisions new types of synthetic rubber developed since the original order was written and to extend it indefinitely. The Order was to have expired as of Dec. 31. All types of synthetic rubber are subject to complete allocation by the terms of the revised Order. The effective date of the allocations is January 1, 1942, except for the poly iso butylene types for which the operative date is February 1, 1942.

The Government acted promptly in December, with outbreak of actual hostilities, to safeguard and conserve imports of 14 minerals upon which the U. S. is partially or almost wholly dependent upon foreign supplies.

CHEM. & MET.

Weighted Index of Prices for

OILS & FATS

Base = 100 for 1937

This month	**135.60**
Last month	129.80
January, 1941	75.28
January, 1940	75.64

Trading in oils was partially suspended by an order placing ceiling prices at levels prevailing on Nov. 26. Later this was changed making maximum levels accord with values as of Oct. 1 which were higher than the Nov. 26 figures.

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DIESEL ENGINES ELECTRICAL MACHINERY MAGNETOS RAILROAD EQUIPMENT WASHERS-IRONERS

CHEM & MET CURRENT PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.168–$0.173	$0.08½–$0.09	$0.07½–$0.08
Acid, acetic, 28%, bbl., cwt	3.38 – 3.63	3.18 – 3.43	2.23 – 2.48
Glacial 99.5%, drums	9.15 – 9.40	8.68 –10.00	8.43 – 8.68
U. S. P. X 1, 99.5%, dr	10.95 –11.20	10.50 –11.00	10.25 –10.50
Boric, bbl., ton	106.00–111.00	106.00–111.00	106.00–111.00
Citric, kegs, lb	.20 – .23	.20 – .23	.20 – .23
Formic, cbys., lb	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb	1.10 – 1.15	1.10 – 1.15	.90 – 1.00
Hydrofluoric 30% drums, lb	.08 – .08½	.08 – .08½	.08 – .08½
Lactic, 44%, tech., light, bbl., lb	.073– .075	.06½– .06¾	.06½– .06¾
Muriatic, 18°, tanks, cwt	1.05 –......	1.05 –......	1.05 –......
Nitric, 36°, carboys, lb	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –......	18.50 –20.00
Oxalic, crystals, bbl., lb	.11½– .13	.11½– .13	.10½– .12
Phosphoric, tech., c'bys., lb	.07½– .08½	.07½– .08½	.07½– .08½
Sulphuric, 60°, tanks, ton	13.00 –......	13.00 –......	13.00 –......
Sulphuric, 66°, tanks, ton	16.50 –......	16.50 –......	16.50 –......
Tannic, tech., bbl., lb	.71 – .73	.71 – .73	.54 – .56
Tartaric, powd., bbl., lb	.70 –......	.70 –......	.50 –......
Tungstic, bbl., lb	nom.......	nom.......	nom.......
Alcohol, amyl	......–......	......–......	......–......
From Pentane, tanks, lb	.131–......	.131–......	.111–......
Alcohol, Butyl, tanks, lb	.158–......	.10 –......	.09 –......
Alcohol, Ethyl, 190 p'f., bbl., gal.	8.19 – 8.25	7.92½–......	6.04 –......
Denatured, 190 proof	......–......	......–......	......–......
No. 1 special, dr., gal. wks.	.60 –......	.33 –......	.31½–......
Alum, ammonia, lump, bbl., lb	.03¾– .04	.03¾– .04	.03½– .04
Potash, lump, bbl., lb	.04 – .04¼	.04 – .04¼	.03¾– .04
Aluminum sulphate, com. bags, cwt	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt	1.85 – 2.10	1.85 – 2.10	1.60 – 1.70
Aqua ammonia, 26°, drums, lb	.02¼– .03	.02¼– .03	.02¼– .03
tanks, lb	.02 – .02¾	.02 – .02¾	.02 – .02¾
Ammonia, anhydrous, cyl., lb	.16 –......	.16 –......	.16 –......
tanks, lb	.04½–......	.04½–......	.04½–......
Ammonium carbonate, powd. tech., casks, lb	.09¼– .12	.09 – .12	.09 – .12
Sulphate, wks., cwt	1.45 –......	1.45 –......	1.40 –......
Amylacetate tech., from pentane, tanks, lb	.145–......	.125–......	.105–......
Antimony Oxide, bbl., lb	.15 –......	.15 –......	.13–......
Arsenic, white, powd., bbl., lb	.04 – .04¼	.04 – .04¼	.03 – .03½
Red, powd., kegs, lb	nom.......	nom.......	.17 – .18
Barium carbonate, bbl., ton	60.00 –65.00	60.00 –65.00	52.50 –57.50
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb	.10½– .11	.10½– .11	.08½– .10
Blanc fix, dry, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt	2.25 – 2.35	2.00 – 2.10	2.00 – 2.10
Borax, gran., bags, ton	43.00 –......	43.00 –......	43.00 –51.00
Bromine, cs., lb	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags	3.00 –......	3.00 –......	1.90 –......
Arsenate, dr., lb	.06½– .07	.06½– .07	.06½– .06¾
Carbide drums, lb	.04¾– .05	.04¾– .05	.04¾– .05
Chloride, fused, dr., del., ton	19.00 –24.50	19.00 –24.50	19.00 –24.50
flake, dr., del., ton	20.50 –25.00	20.50 –25.00	20.50 –25.00
Phosphate, bbl., lb	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb	.05½–......	.05½–......	.05 –......
Tetrachloride drums, gal	.73 – .80	.73 – .80	.66½– .73
Chlorine, liquid, tanks, wks., lb	2.00 –......	2.00 –......	1.75 –......
Cylinders	.05¼– .06	.05¼– .06	.05¼– .06
Cobalt oxide, cans, lb	1.84 – 1.87	1.84 – 1.87	1.84 – 1.87
Copperas, bgs., f.o.b., wks., ton	18.00 –19.00	18.00 –19.00	18.00 –19.00
Copper carbonate, bbl., lb	.18 – .20	.18 – .20	.10 – .16
Sulphate, bbl., cwt	5.15 – 5.40	5.15 – 5.40	4.75 – 5.00
Cream of tartar, bbl., lb	.57 –......	.57 –......	.43¼–......
Diethylene glycol, dr., lb	.22 – .23	.22 – .23	.22 – .23
Epsom salt, dom., tech., bbl., cwt	1.90 – 2.00	1.90 – 2.00	1.80 – 2.00
Ethyl acetate, drums, lb	.12–......	.08½–......	.07½–......
Formaldehyde, 40%, bbl., lb	.05½– .06	.05½– .06½	.05¾– .06
Furfural, tanks, lb	.09 –......	.09 –......	.09 –......
Fusel oil, drums, lb	.17½– .19	.17½– .19	.16 – .17
Glaubers salt, bags, cwt	1.05 – 1.10	1.05 – 1.10	.95 – 1.00
Glycerine, c.p., drums, extra, lb	.18¾–......	.18¾–......	.12½–......
Lead;			
White, basic carbonate, dry casks, lb	.07½–......	.07½–......	.07½–......
White, basic sulphate, sck., lb	.06¾–......	.07¼–......	.07 –......
Red, dry, sck., lb	.08¾–......	.0835......	.08 –......
Lead acetate, white crys., bbl., lb.	.12 – .13	.12 – .13	.11– .12
Lead arsenate, powd., bag, lb	.09½– .11	.09½– .11	.09½– .11
Lime, chem., bulk, ton	8.50 –......	8.50 –......	8.50 –......
Litharge, pwd., csk., lb	.0735......	.0735......	.07 –......
Lithopone, bags, lb	.04½– .04¾	.0385– .04	.038– .04
Magnesium carb., tech., bags, lb.	.06¼– .06½	.06¼– .06½	.06½ – .06½

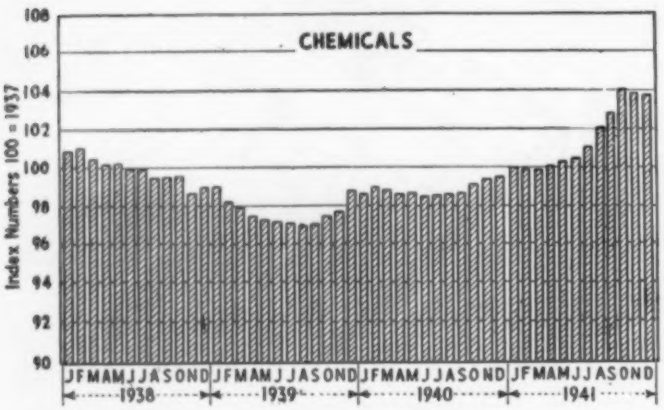
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to January 13

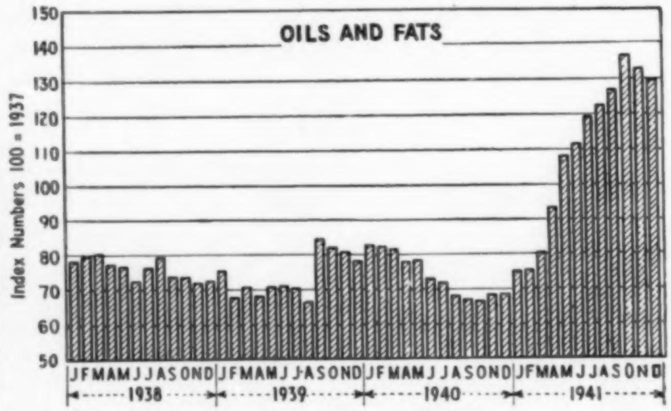
	Current Price	Last Month	Last Year
Menthanol, 95%, tanks, gal	.55½–......	.60 –......	.29 –......
97%, tanks, gal	.55½–......	.60 –......	.30 –......
Synthetic, tanks, gal	.28 –......	.28 –......	.30 –......
Nickel salt, double, bbl., lb	.13½– .13¾	.13½– .13¾	.13 – .13½
Orange mineral, csk., lb	.11½–......	.11½–......	.11 –......
Phosphorus, red, cases, lb	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb	.18 – .25	.18 – .25	.18 – .25
Potassium bichromate, casks, lb	.09½– .10	.09½– .10	.09½– .10½
Carbonate, 80–85%, calc. csk., lb	.06½– .07	.06½– .07	.06½– .07
Chlorate, powd., lb	.10 – .12	.10 – .12	.10 – .12
Hydroxide (c'stic potash) dr., lb	.07 – .07½	.07 – .07½	.07 – .07½
Muriate, 60% bags, unit	.53½–......	.53½–......	.53½–......
Nitrate, bbl., lb	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb	.19½– .20	.19½– .20	.18½– .19
Prussiate, yellow, casks, lb	.17 – .18	.17 – .18	.15 – .16
Sal ammoniac, white, casks, lb	.0515– .06	.0515– .06	.0515– .06
Salsoda, bbl., cwt	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	17.00 –......	17.00 –......	17.00 –......
Soda ash, light, 58%, bags, contract, cwt	1.05 –......	1.05 –......	1.05 –......
Dense, bags, cwt	1.10 –......	1.10 –......	1.10 –......
Soda, caustic, 76%, solid, drums, cwt	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, del., bbl., lb	.04½– .06	.04½– .06	.04 – .05
Bicarbonate, bbl., cwt	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Bichromate, casks, lb	.07½– .08	.07½– .08	.07½– .08
Bisulphate, bulk, ton	16.00 –17.00	16.00 –17.00	15.00 –16.00
Bisulphite, bbl., lb	.03 – .04	.03 – .04	.03 – .04
Chlorate, kegs, lb	.06½– .06¾	.06½– .06¾	.06½– .06¾
Cyanide, cases, dom., lb	.14 – .15	.14 – .15	.14 – .15
Fluoride, bbl., lb	.08 – .09	.08 – .09	.07 – .08
Hyposulphite, bbl., cwt	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt	2.50 – 2.65	2.50 – 2.65	2.35 – 2.40
Nitrate, bulk, cwt	1.47 –......	1.47 –......	1.45 –......
Nitrite, casks, lb	.06½– .07	.06½– .07	.06½– .07
Phosphate, tribasic, bags, lb	2.70 –......	2.70 –......	2.25 –......
Prussiate, yel. drums, lb	.10½– .11	.10½– .11	.10½– .11
Silicate (40° dr.), wks., cwt	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr. lb	.03 – .03½	.03 – .03½	.02¾– .03
Sulphite, crys., bbl., lb	.02¼– .02½	.02¼– .02½	.02¼– .02½
Sulphur, crude at mine, bulk, ton	16.00 –......	16.00 –......	16.00 –......
Chloride, dr., lb	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb	.07 – .08	.07 – .08	.07 – .07½
Flour, bag, cwt	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb	.55 –......	.55 –......	.54 –......
Crystals, bbl., lb	.39½–......	.39½–......	.38 –......
Zinc, chloride, gran., bbl., lb	.05 – .06	.05 – .06	.05 – .06
Carbonate, bbl., lb	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb	.09½–......	.09½–......	.09½–......
Zinc oxide, lead free, bag, lb	.07½–......	.06½–......	.06½–......
5% lead sulphate, bags, lb	.07½–......	.06½–......	.06½–......
Sulphate, bbl., cwt	3.40 – 3.50	3.15 – 3.25	2.75 – 3.00

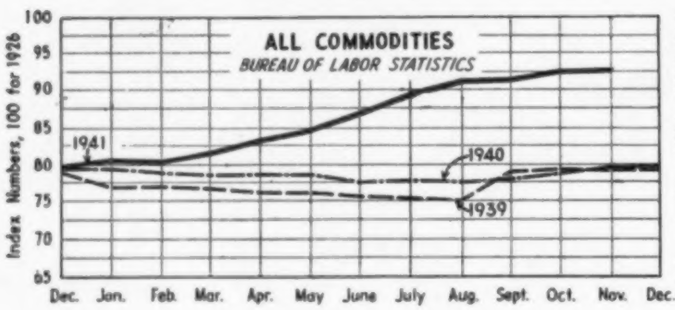
OILS AND FATS

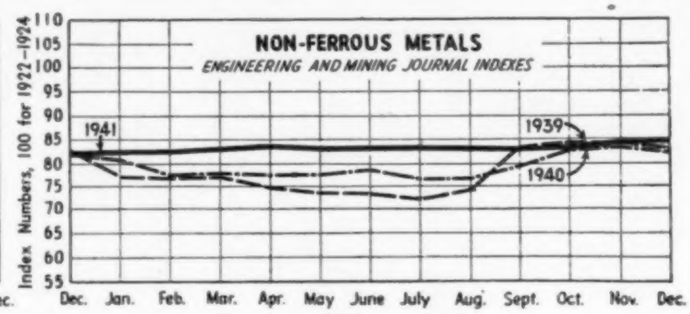
	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb	$0.12½–$0.13	$0.12½–$0.13	$0.10½–$0.11
Chinawood oil, bbl., lb	.35 –......	.35 –......	.27½–......
Coconut oil, Ceylon, tank, N. Y., lb	nom	.07½–......	.03½–......
Corn oil crude, tanks (f.o.b. mill), lb	.12½–......	.11½–......	.06½–......
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.12½–......	.11½–......	.05½–......
Linseed oil, raw car lots, bbl., lb	.111–......	.104–......	.095–......
Palm, casks, lb	.09 –......	.09 –......	.04½–......
Peanut oil, crude, tanks (mill), lb	.13 –......	.12 –......	.05½–......
Rapeseed oil, refined, bbl., lb	nom	.15½–......	.13½–......
Soya bean, tank, lb	.11½–......	.10½–......	.05½–......
Sulphur (olive foots), bbl., lb	.19 –......	.17 –......	.10 –......
Cod, Newfoundland, bbl., gal	nom	nom	nom ......
Menhaden, light pressed, bbl., lb	.112–......	.112–......	.078–......
Crude, tanks (f.o.b. factory) gal.	.60 –......	.60 –......	.30 –......
Grease, yellow, loose, lb	.09½–......	.08½–......	.04½–......
Oleo stearine, lb	.09½–......	.09½–......	.06½–......
Oleo oil, No. 1	.11½–......	.11½–......	.06½–......
Red oil, distilled, dp.p. bbl., lb	.12 –......	.12 –......	.06½–......
Tallow extra, loose, lb	.09½–......	.09 –......	.05 –......

Chem. & Met.'s Weighted Price Indexes









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb	$0.52 –$0.55	$0.52 –$0.55	$0.52 –$0.55
Alpha-naphthylamine, bbl., lb	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb	.15 – .16	.15 – .16	.15 – .16
Aniline, salts, bbl., lb	.22 – .24	.22 – .24	.22 – .24
Benzaldehyde, U.S.P., dr., lb	.85 – .95	.85 – .95	.85 – .95
Benzidine base, bbl., lb	.70 – .75	.70 – .75	.70 – .75
Benzoic acid, U.S.P., kgs., lb	.54 – .56	.54 – .56	.54 – .56
Benzyl chloride, tech., dr., lb	.23 – .25	.23 – .25	.23 – .25
Benzol, 90%, tanks, works, gal	.15 –......	.14 –......	.14 –......
Beta-naphthol, tech., drums, lb	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb	.11 –......	.10½– .11	.09½– .10
Cresylic acid, dr., wks., gal	.81 – .83	.81 – .83	.58 – .60
Diethylaniline, dr., lb	.40 – .45	.40 – .45	.40 – .45
Dinitrophenol, bbl., lb	.23 – .25	.23 – .25	.23 – .25
Dinitrotoluol, bbl., lb	.18 – .19	.18 – .19	.15½– .16
Dip oil, 15%, dr., gal	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, dr. f.o.b. wks., lb	.60 –......	.70 –......	....
H-acid, bbl., lb	.45 – .50	.45 – .55	.45 – .50
Naphthalene, flake, bbl., lb	.07 – .07½	.07 – .07½	.07 – .07½
Nitrobenzene, dr., lb	.08 – .09	.08 – .09	.08 – .09
Para-nitraniline, bbl., lb	.47 – .49	.47 – .49	.47 – .49
Phenol, U.S.P., drums, lb	.13 –......	.13 –......	.12 –......
Picric acid, bbl., lb	.35 – .40	.35 – .40	.35 – .40
Pyridine, dr., gal	1.70 – 1.80	1.70 – 1.80	1.70 – 1.80
Resorcinol, tech., kegs, lb	.75 – .80	.75 – .80	.75 – .80
Salicylic acid, tech., bbl., lb	.33 – .40	.33 – .40	.33 – .40
Solvent naptha, w.w., tanks, gal	.27 –......	.27 –......	.27 –......
Tolidine, bbl., lb	.86 – .88	.86 – .88	.86 – .88
Toluol, drums, works, gal	.33 –......	.30 –......	.30 –......
Xylol, com, tanks, gal	.26 –......	.26 –......	.26 –......

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech, bbl., lb	.29½– .30	.23 – .26	.13 – .14
China clay, dom., f.o.b. mine, ton	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors			
Carbon gas, black (wks.), lb	.0335– .30	.0335– .30	.02½– .30
Prussian blue, bbl., lb	.36 – .37	.36 – .37	.36 – .37
Ultramarine blue, bbl., lb	.11 – .26	.11 – .26	.10 – .26
Chrome green, bbl., lb	.21½– .30	.21½– .30	.21 – .27
Carmine, red, tins, lb	4.60 – 4.75	4.60 – 4.75	4.85 – 5.00
Para toner, lb	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb	3.05 – 3.10	3.20 – 3.25	3.12 – 3.20
Chrome yellow, C.P., bbl., lb	.14½– .15½	.14½– .15½	.14½– .15½
Feldspar, No. 1 (f.o.b.N.C.), ton	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb	.08 – .10	.08 – .10	.06 – .06½
Gum copal Congo, bags, lb	.09 – .30	.09 – .30	.06 – .30
Manila, bags, lb	.09 – .15	.09 – .14	.09 – .14
Damar, Batavia, cases, lb	.10 – .22	.10 – .20	.08 – .24
Kauri, cases, lb	.18 – .60	.18 – .60	.18½– .60
Kieselguhr (f.o.b. mines), ton	7.00 –40.00	7.00 –40.00	7.00 –40.00
Magnesite, calc, ton	64.00 –......	65.00 –......	65.00 –......
Pumice stone, lump, bbl., lb	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb	nom	nom	.03 – .04
Rosin, H., 100 lb	3.76 –......	3.48 –......	2.52 –......
Turpentine, gal	.82 –......	.79½–......	.47 –......
Shellac, orange, fine, bags, lb	.43 –......	.43 –......	.27 –......
Bleached, bonedry, bags, lb	.40 –......	.40 –......	.27 –......
T. N. Bags, lb	.32 –......	.32 –......	.16 –......
Soapstone (f.o.b. Vt.), bags, ton	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc. 200 mesh (f.o.b. Vt.), ton	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
200 mesh (f.o.b. Ga.), ton	6.00 – 8.00	6.00 – 8.00	7.50 –11.00

Industrial Notes

THE CARBORUNDUM Co., Perth Amboy, N. J., has appointed R. A. Barr sales manager for the refractory division in the Chicago territory.

CARNEGIE-ILLINOIS STEEL CORP., Chicago, has placed T. Lane Watson in charge of sales in the Cincinnati district to succeed William P. Andrews who has been made sales manager in the Cleveland territory.

PITTSBURGH EQUITABLE METER Co. and MERCO NORDSTROM VALVE Co., Pittsburgh, have opened a new sales office in San Francisco at 582 Market St. with Russ Waters in charge. An office also has been opened at 119 West Denny Way, Seattle, with Frank P. Tangney in charge of water meter sales and William R. Dominick heading up industrial sales.

LESTER KEHOE MACHINERY CORP., New York, has been formed with offices at 1 East 42d St. Lester D. Kehoe is the head of the new company.

FOOTE MINERAL Co., Philadelphia, has purchased a grinding and milling plant at Exton, Pa. John Worcester has been engaged to direct remodeling operations of the Exton plant.

THE PERMUTIT Co., New York, announces that its subsidiary, Permutit Co. of Canada, Ltd., has appointed S. A. McWilliams, Ltd., Toronto, as its representative in the Province of Ontario.

RUMFORD CHEMICAL WORKS, Rumford, R. I., has made Raymond E. Gaylord acting sales manager for New England to succeed Theodore L. Sweet who has been given leave of absence to accept a post with OPM in Washington.

LINK-BELT Co., Chicago, has moved its sales offices from Philadelphia to 420 Lexington Ave., New York. K. C. Ellsworth is in charge of the office.

THE LINCOLN ELECTRIC Co., Cleveland, has opened an office in Jacksonville, Fla. J. M. Chapple has been moved from the Detroit office to take charge of the new branch.

HENRY L. CROWLEY & Co., INC., West Orange, N. J., has enlarged its plant and productive activities and placed William M. Siesel in charge of operations.

JOHN A. ROEBLING'S SONS Co., Trenton, has advanced Eugene King to the position of manager of its Cleveland branch to succeed Raymond R. Newell who retired after 39 years service with the company.

PENNSYLVANIA SALT MFG. Co., Philadelphia, has started operations at its new plant at Portland, Ore. The new plant is producing chlorate of potash and chlorate of soda.

MONSANTO CHEMICAL Co., St. Louis, has purchased the plant of the Texas City Sugar Refinery near Galveston and will use the property for the manufacture of rubber chemicals.

No. 3 in a series of advertisements about new research chemicals.

Announcing 4 Newcomers for Laboratory Study

N-ETHYL MORPHOLINE
ACETOACET-O-TOLUIDIDE
DIMETHYLETHANOLAMINE
"CELLOSOLVE" BENZYLOXYGLYCOL

HERE are four new synthetic organic chemicals available in research quantities. They should be of special interest if you make emulsions, dyestuffs, pharmaceuticals, or rubber accelerators . . . if you use solvents for lacquers, dyestuff pastes, printing inks, or coating compositions . . . or if you can develop new products and processes using synthetic organic chemicals.

These chemical newcomers were synthesized in our laboratories, and the supply is limited. However, commercial quantities may be made available in the future when large-scale applications develop. Write for quotations.

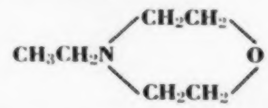
For information concerning the use of these chemicals, address:

Carbide and Carbon Chemicals Corporation

Unit of Union Carbide and Carbon Corporation

30 East 42nd Street UCC New York, N. Y.

N-ETHYL MORPHOLINE



. . . is a colorless, water-miscible liquid boiling at 138°C. This cyclic tertiary amine is potentially useful as a solvent for dyes, resins, and oils, and as an intermediate in the manufacture of dyestuffs, pharmaceuticals, rubber accelerators, and emulsifying agents. Its molecular weight is 115.17; its specific gravity at 20/20°C., 0.916.

ACETOACET-O-TOLUIDIDE

$CH_3COCH_2CONHC_6H_4CH_3$

. . . is a fine, white, granular powder which melts at 106°C., and contains active methylene and carbonyl groups. It is very similar to acetoacetanilide and is also used as an intermediate in the manufacture of "Hansa" and "benzidine" pigments. It is slightly soluble in water and is soluble in dilute alkalies. Its molecular weight is 191.22.

DIMETHYLETHANOLAMINE

(Dimethylaminoethanol)

$(CH_3)_2NCH_2CH_2OH$

. . . is a colorless, amine-odored liquid which is miscible with water and benzene. Its properties are similar to those of diethylethanolamine (diethylaminoethanol) which has been used commercially for many years. It should be useful in the synthesis of dyestuffs, textile auxiliaries, pharmaceuticals, and corrosion inhibitors. Its physical properties include: boiling point, 133°C.; specific gravity at 20/20°C., 0.887; equivalent weight, 89; refractive index, 1.4300.

"CELLOSOLVE" BENZYLOXYGLYCOL

(Ethylene Glycol Monobenzyl Ether)

$C_6H_5CH_2OCH_2CH_2OH$

. . . has the high boiling point of 255.9°C., and its vapor pressure is about the same as "Cellosolve" Phenoxyglycol. It is well-suited as a high-boiling solvent in lacquers, dyestuff pastes, printing inks, and in coating compositions for paper, leather, and cloth. Its specific gravity at 20/20°C. is 1.0700. It is 0.4 per cent soluble in water.

PRODUCERS OF SYNTHETIC ORGANIC CHEMICALS

CHEM & MET NEW CONSTRUCTION

	Current Projects: Proposed Work	Current Projects: Contracts	Cumulative 1941: Proposed Work	Cumulative 1941: Contracts
New England	....	....	$2,955,000	$6,758,000
Middle Atlantic	$611,000	$539,000	31,381,000	56,845,000
South	....	15,000,000	63,473,000	265,916,000
Middle West	3,040,000	....	114,175,000	225,337,000
West of Mississippi	3,430,000	4,586,000	134,525,000	262,325,000
Far West	....	14,000,000	39,355,000	74,358,000
Canada	332,000	172,000	3,334,000	4,666,000
	$7,413,000	$34,297,000	$389,198,000	$896,205,000

PROPOSED WORK

Ark., Sweet Home—Dulin Bauxite Co., Sweet Home, plans to construct a bauxite drying plant here. Estimated cost including equipment $50,000.

Ill., Chicago—Jordan Co., 5100 S. Merrimac Ave., plans to construct a 1 and 2 story addition to chemical plant. Estimated cost $100,000.

Ill., Monsanto—Monsanto Chemical Co., 1700 South Second St., St. Louis, Mo., plans to construct a 2 story, 70x80 ft. addition to its chemical plant for the War Dept. W. J. Knight & Co., Wainwright Bldg., St. Louis, Ch. Engineer. Estimated cost $310,200.

Ind., Charleston—War Dept., 20 St. and Constitution Ave. N.W., Wash., D. C., plans constructing a pulp plant to produce cellulose at Indiana Ordnance Works. $2,500,000 allocated.

Mont., Polson—J. E. Busey, L. Helmer and L. L. Marsh, have selected a site and are making financial arrangements for constructing a pulp and paper mill. L. A. DeGuerre, Wisconsin Rapids, Wis., Engr. Estimated cost $2,000,000.

N. J., Linden—Standard Oil Co. of New Jersey, 500 North Broad St., Elizabeth, N. J., plans to construct additional buildings at its refinery here. Estimated cost $85,500.

N. J., Newark—U. S. Industrial Chemicals, Inc., 390 Doremus Ave., Newark, N. J., is receiving bids for alterations to Building No. 23. Estimated cost $75,000.

N. Y., Wellsville—Empire Gas & Fuel Co., Ltd., Wellsville, plans extensive development of deep sand natural gas properties in Allegany and Steuben Counties, including drilling number of 1000 to 4000 ft. wells, connecting pipe lines, etc. Estimated cost will exceed $50,000.

Mich., Wyandotte—Firestone Metal & Rubber Products Co., is having plans prepared by Russell Engineering Co., Engrs., 607 Shelby St., Detroit, for a brick, steel and reinforced concrete boiler house. Estimated cost $50,000.

Pa., Philadelphia—Atlantic Refining Co., 260 South Broad St., plans to construct a gasoline refinery. Estimated cost will exceed $400,000.

Tex., Corpus Christi—Pontiac Oil Co., Corpus Christi, plans to construct a 100 octane gasoline refinery. Estimated cost $150,000.

Tex., Corpus Christi—Terminal Oil Co., Corpus Christi, plans to construct a 100 octane gasoline refinery. Estimated cost $150,000.

Tex., Houston—Shell Oil Co., Shell Building, to construct a 1 story storage and utility building in connection with synthetic rubber plant. Estimated cost exceeds $40,000.

Tex., Houston—Shell Oil Co., Shell Bldg., contemplates the construction of a 100 octane gasoline refinery. Estimated cost $150,000.

Tex., Nederland—Pure Oil Co., Nederland, contemplates the construction of a 100 octane gasoline refinery. Estimated cost $150,000.

Tex., Odessa—Stanolind Oil & Gas Co., Dallas, and Fair Bldg., Ft. Worth, plans to enlarge its refinery here. Estimated cost $250,000.

Tex., Port Arthur—Texas Co., Port Arthur, contemplates the construction of a 100 octane gasoline refinery. Estimated cost $150,000.

Tex., San Angelo—U. S. Dist. Engr., Federal Bldg., Galveston, will receive bids until Jan. 10 for constructing ordnance buildings at Goodfellow Field to include photographic magazine, chemical bomb magazine, etc.

Tex., Texas City—Republic Oil & Refining Corp., Texas City, contemplates the construction of a 100 octane gasoline refinery. Estimated cost $150,000.

Tex., Texas City—Southport Oil Co., Texas City, plans to construct a 100 octane gasoline refinery. Estimated cost $150,000.

Wis., Wausau—Marathon Rubber Products Co., Wausau, plans to construct a 1 story, 100x100 ft. addition to its factory.

Wis., Kaukauna—Sangamon Paper Mills, Kaukauna, plan to construct a 2 story, 48x60 ft. addition to their mill.

Alta., Fort McMurray—Abasand Oils, Ltd., Edmonton, Alta., plans to construct a separation plant, laboratory, etc., here. Estimated cost $200,000.

Ont., St. Thomas—Canada Vitrified Products, Ltd., 21 Talbot St., is having plans prepared by J. T. Findlay, Acht., 17 Hincks St., for an addition to its plant. Estimated cost $40,000.

Que., Montreal—Stuart Bros. Co., Ltd., 202 Youville Sq., manufacturer of essential oils, contemplates the construction of an addition to its plant. T. Pringle & Son, Ltd., 485 McGill St., Engr. Estimated cost $50,000.

Que., Montreal—International Paints of Canada, Ltd., 6700 Park Ave., Montreal, is having plans prepared by T. Pringle & Son, Ltd., Engr., 485 McGill St., for an addition to its plant. Estimated cost $42,000.

CONTRACTS AWARDED

Ark., Stamps—McKamie Gas Cleaning Co., has awarded the contract for hydrogen sulphide extraction plant, to Girdler Corporation, Stamps, Ark. Estimated cost including equipment $3,000,000.

Ariz., Miami—Castle Dome Copper Co., subsidiary of Miami Copper Co., 61 Bway., New York, N. Y., has awarded the contract for the construction of a plant to produce 46,000,000 lb. of electrolytic copper per year to W. A. Bechtel Co., 155 Sansome St., San Francisco. Defense Plant Corp. will finance. Estimated cost $9,000,000.

Calif., Los Angeles—Defense Plant Corp., 811 Vermont Ave., N. W., Wash., D. C., has awarded the contract for concrete work and grading for aluminum reduction plant, 31 buildings, to P. J. Walker Co., 3900 Whiteside Ave.; structural steel to Bethlehem Steel Co., 11100 South Central Ave. Estimated cost $5,000,000.

N. J., Bayonne—Baker Castor Oil Co., 35 Avenue A, has awarded the contract for a 3 story, 30x84 ft. addition to its press building to James Mitchell, Inc., 575 West Side Ave., Jersey City.

N. J., Bound Brook—Bakelite Corp., River Road, has awarded the contract for a 4 story, basement, 38 x 82 ft. oxide building and a 3 story, basement, 38 x 162 ft. Amine Building, to L. C. Roberts, 1 East 42 St., New York, N. Y. Estimated cost exceeds $40,000.

N. J., Keasbey—General Ceramics Co., Crows Mill Road, has awarded the contract for 1 story addition to Steatite Insulator building, to I. Daniels, 18 Locust St., Carteret, N. J. Estimated cost including equipment $132,876.

N. J., Linden—Standard Oil Co. of New Jersey, 500 N. Broad St., Elizabeth, will construct a 1 and 2 story, 26 x 63 ft. switch equipment house, 1 story, 37 x 52 ft. catalyst building, 1 story, 10 x 13 ft. instrument control house, 1 story, 20 x 30 ft. office building. Work will be done by separate contracts. Estimated cost $85,500.

N. J., Linden—Standard Oil Co. of New Jersey, 500 North Broad St., Elizabeth, has awarded the contract for the construction of a salt water suction crib and pump house at its refinery to Merritt-Chapman & Scott Corp., 17 Battery Pl., New York, N. Y. Estimated cost $150,000.

N. J., West Paterson—J. Schmid, Inc., Jackson Lane, has awarded the contract for a 2 story, 50x192 ft. rubber testing building to Weng Bros. & Storms Co., 241 Lafayette St., Paterson, at $40,000.

Okla., Enid—Champlin Refining Co., Enid, is having plans prepared for the construction of a 1000 bbl. capacity refinery to manufacture 100 octane gasoline. Estimated cost $1,500,000.

Okla., Oklahoma City—Phillips Petroleum Co., Bartlesville, is having plans prepared by S. S. Learned, Engr., Bartlesville, for the construction of a 1000 bbl. 100 octane gasoline refinery. Estimated cost $3,000,000.

Pa., Emlenton—Quaker State Oil Refining Corp., Oil City, G. S. Hunter, Supt., will construct a solvent dewaxing unit addition to its crude oil refinery. Work will be done by separate contracts. Estimated cost between $40,000 and $50,000.

Tex., Waco—Owens-Illinois Glass Co., Tower Petroleum Bldg., Dallas, has awarded the contract for excavating and reinforced-concrete foundation for plant to Ace Foundation Co., 117 North Lancaster St., Dallas, at $86,000.

W. Va., Morgantown—War Dept., Wash., D. C., has awarded the contract for design and construction of additional unit at Morgantown Ordnance Plant to E. I. du Pont de Nemours & Co., Du Pont Bldg., Wilmington. Estimated cost $15,000,000.

Alta., Fort McMurray—Abasand Oils, Ltd., 10019 101st Ave., will construct a tar oil plant. Work will be done by day labor. Estimated cost $50,000.

Ont., Hamilton—Procter & Gamble Co. of Canada, Ltd., 14 Burlington St., E., has awarded the contract for a 1 story warehouse addition to W. H. Cooper Construction Co., Ltd., Medical Arts Bldg., at $42,000.

Ont., Kitchener—Perkins Glue Co., Inc., Lansdale, Pa., plans to remodel its existing buildings here and construct additions. Estimated cost $40,000.

Sask., Gladmar—Sybouts Sodium Sulphate Co., Ltd., Gladmar, plans to reconstruct its plant here and construct additions. Estimated cost $40,000.